A STUDY OF PST ON FISHER ESD VALVES

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A Study of Partial Stroke Testing on FISHER ESD Valve

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CERTIFICATION OF APPROVAL

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Approved:

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Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

June 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Zaid.

Zaid Bin Najid

ABSTRACT

Partial Stroke Testing (PST) is an online testing of Emergency Shutdown Valve (ESDV) to test and exercise the functionality of the ESDV so that when real emergency occur, the ESDV will stroke as per required. The reliability of PST implementation in plant through out the world is still in question. The SKG14 (Instruments) has setup an Improvement Working Group (IWG) PETRONAS Group Technology Solution (GTS) to initiate and clarify about PST and establish a standard procedure on PST. The testing are involved by three hosts namely, FISHER, Metso Neles and Masoneilan. The primary objective of this project is to complete 90-days of testing for FISHER PST system and this objective had been achieved. Next the Phase II of the project which is the stress testing is at the stage of designing the mini process plant.

ACKNOWLEDGEMENTS

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ABBREVIATIONS

PST	Partial Stroke Valve Testing
FST	Full Stroke Valve Testing
ESDV	Emergency Shut Down Valve
SOV	Solenoid Valve
PLC	Programmable Logic Controller
SIS	Safety Instrumented System
GTS	Group Technology Solution
HART	Highway Addressable Remote Transducer
PC	Personal Computer
PTS	PETRONAS Technical Standard

CHAPTER 1
INTRODUCTION

1.1 Background of Study

ESDV is an important element in a safety safeguarding system. It usually functions as the final element for process isolation when emergency occurred such as when high level in a vessel thus inlets to the vessel need to be shut down. Consequently it is important for ESDV to function when the real emergency occurred so that the mass damage to the equipments and workers will be reduced.

However, in the real situation, ESDV has high probability to be in a failure mode when it is required because of the long idling duration of ESDV. As a result, testing the ESDV regularly is only one way to solve the problem. With that, there are two ways of testing, online testing and offline testing.

Offline testing can only be done during turn-around of the plant. Even though the offline testing can be done thoroughly to ESDV, but the risk to take is still high because the turn-around of any plant will only be done once within 3 to 5 years. And yet the probability of ESDV is getting higher as the idling time increased. Plus turn-around will cause the loss of the production.

Online testing for ESDV will much more cost-saving due to the continuation on the production. This is where PST took place. PST is being done while the operation of the production is online. It been called Partial Stroke Testing because what happen in the testing is that an ESDV is being instructed to just been partially stroke (usually about 10%-20% closing because process will not be affected by this percentage of closing) to check the availability of ESDV [1]. And of course the partially stroking of the ESDV will not be an interrupt to the production process.

1.2 Problem Statement

Turn-around being planned further apart, ranging from 3 to 6 months during shut down window. The inability to conduct full stroke test within the required period, causing safety issues to arise due to ESD valves being stuck in position due to the very long period in one fixed position. As PST technology is still new in Oil & Gas industry, it is afraid that the PST itself may cause the ESDV to unable to close during any emergency. Thus it is unknown about the improvement or coverage that PST can offer compare to FST. The facility is meant for comparison and verification of the technology used for PST of ESDV. The work includes the development of the controller to execute the FST and PST sequences, data mining and analysis.

1.3 Objective

The objectives of the project are:

i. To perform PST on the FISHER Valve and record all the data gained.
ii. To ignite a Full Stroke Testing (FST) instruction while the PST is being running (it is to mimic a situation when at real site, while the PST is being done, a real emergency alarm activated).
iii. To analyze the set of data gained from the completed 90-days of testing of Phase I specifically on the performance of the PST
iv. To establish a test procedure as a guideline for PETRONAS plant and its subsidiaries to conduct a PST using FIHSER system.
v. To design a mini process plant that allows real flow (water) through the ESD valves during the PST and then continue testing for Phase II.

1.4 Scope of Study

This project is done to analyze, compare and verify the performance of PST applied on FISHER ESD valves. The completed Phase I was to analyze the valve performances by using the data gathered during 90 days of valve testing. Phase II is to perform stress test for the PST as a real medium which is water that flow through the valves. The reliability and feasibility study will be carried out to achieve the objectives. Since this is one of the UTP projects collaborate with GTS, it is desirable to follow the PETRONAS Technical Standard (PTS).

CHAPTER 2
LITERATURE REVIEW/THEORY

2.1 Valve Assembly and Its Component

The whole part of a valve is called valve assembly. Valve assembly includes all components normally mounted on the valve: the valve body, actuator, positioner, air seats, transducer, limit switches, etc [2].

2.1.1 Valve Body

Valve body is one of the major parts in valve assembly. It can be either rotary type such as ball valve and butterfly or sliding type such as globe valve and flanged valve. But according to ***PTS 32.36.01.17***, *ball valves shall be considered for on-off service [8].*

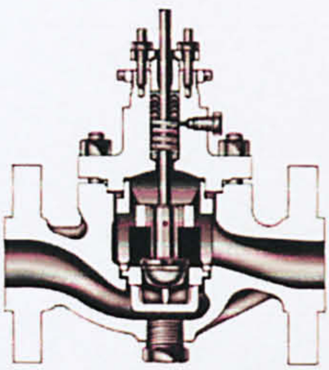


Figure 1 :Single Ported Globe Valve

Figure 2 : Butterfly Valve

Figure 3 V-Notch Ball Valve

2.1.2 Actuator

Actuator is another major part in valve assembly. An actuator is a powered device that supplies force and motion to open or close the valves. The power source varies from pneumatic, hydraulic, or electrical. There are many actuator styles manufactured by FISHER such as diaphragm, piston, rack and pinion, electro-hydraulic, manual and electric actuators. The actuator used in this project is rack and pinion actuator as shown in Figure 2.5 [2].

Figure 4 : Rack & Pinion Actuator

2.1.3 Limit Switch

The purpose of limit switch is to alert when a valve is at or beyond a predetermined position because it shows the position of the valve stem at a particular instant of time. It operates discrete inputs to a distributed control system, signal lights, small solenoid valves, electronic relays, or alarms [3].

Figure 5 : VALVETOP DXP Limit Switch

2.1.4 Digital Valve Controller (DVC) SIS / SMART Positioner

Figure 6 shows a digital valve controller or also known as smart positioner. It is a microprocessor-equipped device. It controls the opening and closing of the valve by converting the 4-20mA DC current signal input from process controller and converts it to pneumatic output signal to the actuator. However it also can be powered up by using 0-24 VDC. Besides, it communicates via Highway Addressable Remote Transducer (HART) communication protocol to provide instrument and valve diagnostic information. The smart SIS positioner plays an important role in Emergency Shutdown (ESD) application. This smart SIS positioner differs with normal positioner physically by the SIS sticker on the cap of the terminal block and the microprocessor inside the positioner which we cannot see. It will reduce the testing time taken and manpower requirement, thus it will reduce cost. The diagnostic capability of the smart positioner reports the health of the valve, thus reducing the need for scheduled maintenance and increasing process availability [4].

Figure 6 : DVC6000 Digital Valve Controller

2.1.5 Solenoid Valve

A solenoid valve (SOV) is an electromechanical valve for use with liquid or gas controlled by running or stopping an electric current through a solenoid, which is a coil of wire, thus changing the state of the valve. The operation of a solenoid valve is similar to that of a light switch, but typically controls the flow of air or water, whereas a light switch typically controls the flow of electricity [5].

Figure 7 : Solenoid Valve

2.1.6 Programmable Logic Controller

The Programmable Logic Controller (PLC) is a device that is specifically designed to receive input signals and emit output signals according to the program logic. PLCs come in many shapes and sizes from small, self-contained, units with very limited input/output capacity to large, modular units that can be configured to provide hundreds or even thousands of inputs/outputs. The PLC-based system becomes the most common choice for manufacturing controls including process plant since it can cut production cost and increase quality.

2.2 PST Installation and Principle of Operation

2.2.1 Installation

The DVC is a positioner that must be fitted to the valve. The components embedded inside the DVC6000SIS unit include: I/P converter, pneumatic relay, position sensor, Instrument Air pressure sensor, Actuator Air pressure sensors and micro controller.

It comes in two models:-

- Milliamp input (0-20 mA)
- Voltage input (24 VDC)

There are three types of installation that are possible for a shut down valve system.

1. 4-wire installation (milliamp input)
2. 2-wire installation (voltage input)
3. 2-wire installation with the solenoid valve removed (voltage or milliamp input)

2.2.1.1 4-wire Installation (milliamp input)

In the 4-wire installation the SIS provides two separate signals: A 4-20mA signal to the DVC and the normal 24VDC signal to the solenoid valve. The 4-20mA is used as the primary valve position control signal. Although Figure 8 [1] shows it from the SIS, it could come from DCS/AMS. The 24VDC signal serves as an independent means of tripping the valve as in Figure 8 [1]. When the SIS trips, the DVC will capture the state one point before and one point after the state change of the solenoid. And this is the installation that been applied to the FISHER butterfly valve in the lab.

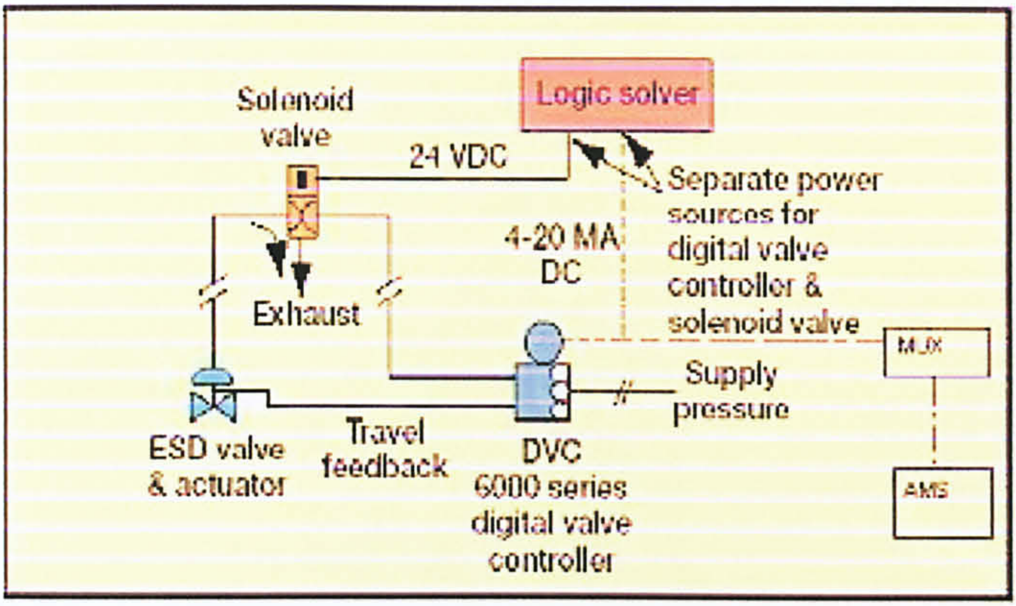


Figure 8 : DVC 4 Wire

In the 2-wire installation the SIS provides one signal: a 24VDC to both the DVC6000 digital controller and the solenoid valve. This method saves wiring cost but requires a line conditioner. Figure 9 [1] shows the installation setup. The 2-wire installation with the solenoid valve removed as in Figure 9, the SIS provides 24V the DVC6000. The FISHER ball valve for this project was installed according to this type of installation but having the Line Conditioner. The reason being for this type of installation is to test the effect of installation without SOV of the FieldVue DVC 6000 Positioner on the Emergency Shut Down system specifically on the PST function. Furthermore installation with SOV practically will result in the malfunction of the SOV itself during real emergency demand.

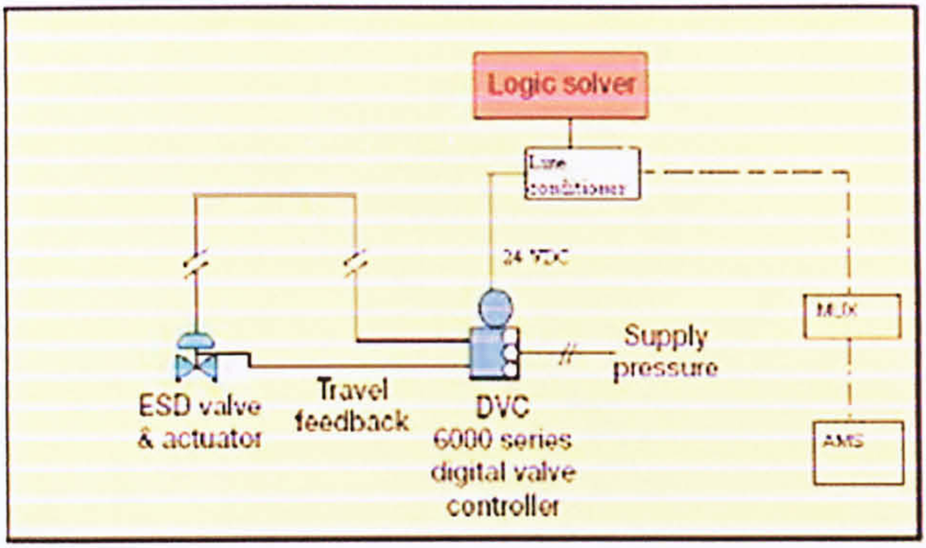


Figure 9 : DVC 2 Wire

The 2-wire installation with the solenoid valve removed is as in Figure 10 [1], but the AMS provides 4-20mA to the DVC6000.

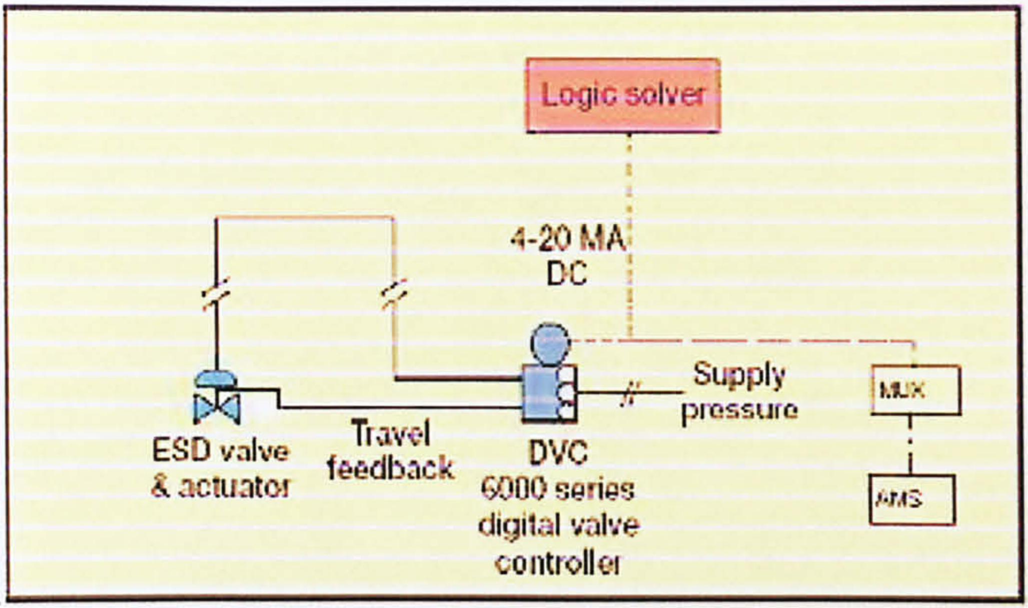


Figure 10 : DVC 2 Wire – no solenoid

2.2.2 *Principle of Operation*

A partial stroke test command can be initiated by one of the following:

- AMS Valvelink Software
- 375 Communicator HART HANDHELD
- Remote Push Button (Control Panel)

When the DVC receives the partial stroke test command (via HART) it moves the valve to the user-defined end of partial stroke and then returns the valve to its original position. The default value for the partial stroke is 10% from its original position, but this can be customized to any value up to 30% of its original position. The DVC also allows the speed of the partial stroke test to be modified if required. If the valve were to be stuck while performing the partial stroke test the DVC will return the actuator air to its normal pressure, after setting an alert that the valve is stuck.

CHAPTER 3
METHODOLOGY

3.1 Procedure Identification

Figure 11 below describe the flow chart of this project and will implemented through out the time.

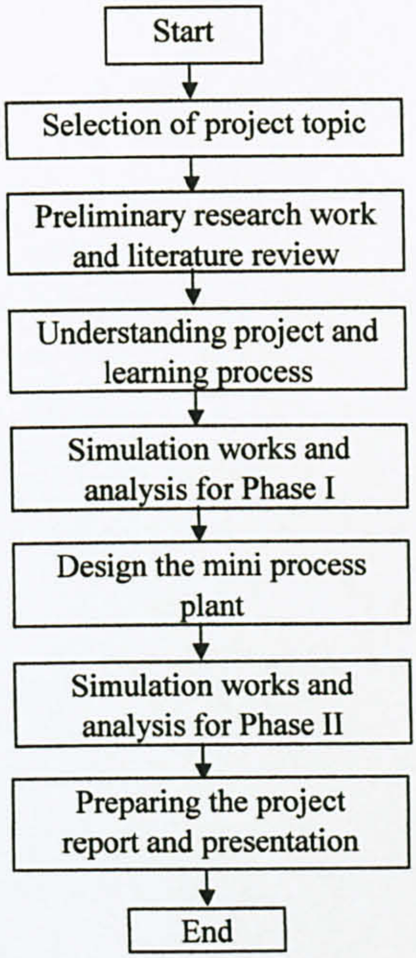


Figure 11 : Process Flow of the Project

The first step is to select the project topic and conduct the preliminary researches and literature review. Journals, conference papers, books and internet are referred. As the information is available, it is very crucial for the author to undergo the learning process as the valve, PST and PLC are not a familiar area. From the data gathered, the author gets the basic understanding what the project is all about. The next step is development programming for the PLC and setting the software. Then, the simulation works and analysis are conducted for Phase I.

Next is to design the mini process plant to allow real flow (water) through the valve. Then the testing for the Phase II can be executed. Data gathered from the Phase II testing will be analyze and proceed for a proper reporting to the Final Year Project Committee. There is also an oral presentation which will take place towards the end of the semester.

3.2 Project identification

The main task in this project is to conduct PST for FISHER Emergency Shutdown Valve for 90 days. The relevant valve's data such as cycle count, travel acceleration and travel accumulator will be captured so that further analysis can be done to verify and compare the performance of the testing as well as the valves with the other two vendors. As for FISHER valves, this project needs the AMS ValveLink software to execute the PST and WideField2 for ignite the FST command.

3.2.1 PLC Programming for FST by Using Ladder Diagram

The program is developed on the PLC by using ladder diagram to perform FST. The Analog Input Module position consists of 4 functions as shown in the Table 1 below.

Table 1 : Functions in PLC Program

Function	Data Region	Program
Function I	Mode of operation	Each channel will be stored with the operation mode
Function II	Detail Data Operation	Upper and lower limit of the scaling will be introduced
Function III	Data Input	Input voltage data will be installed in each channel
Function IV	Execution of Program	The program will be execute by using the internal relay

3.2.1.1 Function I – Mode of Operation

In Function I, in the mode of operation, the sequence CPU failure is developed by a channel-by-channel basis. A data location number is set to 1 to set output values in a sequence of CPU failure. When the power is turned off, the set items in the mode of operation are canceled in a sequence CPU failure [6]. The data location number in the mode of operation in a sequence CPU failure is shown in Table 2.

Table 2 : Data location number in the mode of operation in a sequence CPU failure

Set items	Channel 1	Channel 2	Channel 3	Channel 4
Mode of operation	501	502	503	504

A special module, WRITE, is used for this setting. Figure 12[4] shows the special module, WRITE, that used in the ladder diagram.

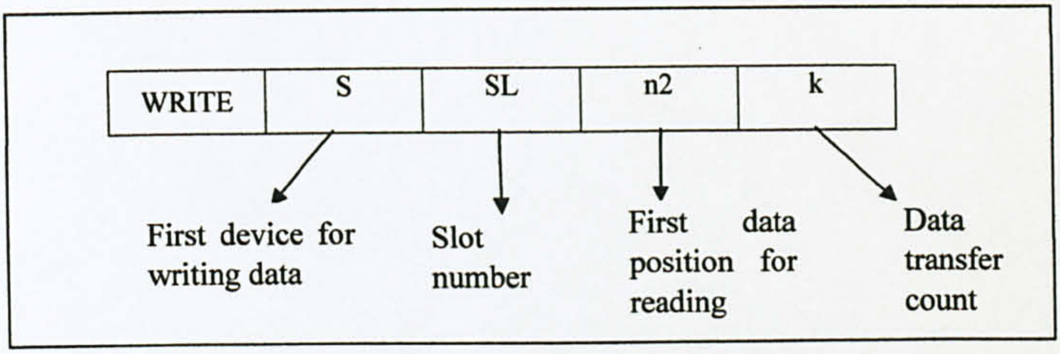


Figure 12 :WRITE symbols

Figure 13 and Figure 14 show the WRITE instruction for power failure in rung 1 for ball valve program and butterfly valve program, respectively.

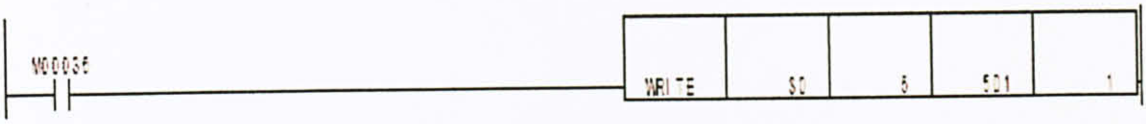


Figure 13 :Rung 1 for ball valve program

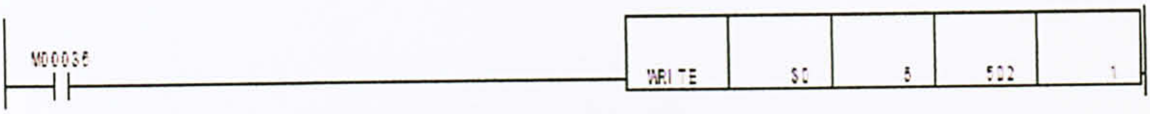


Figure 14 :Rung 1 for butterfly valve program

3.2.1.2 Function II – Detail Data Operation

The upper-and-lower limit value corresponding to the digital input values in the output signal range is set to 0 and 10000, which is for 0mA and 20mA respectively [7]. However, the data location numbers for scaling had been set on a channel-by-channel basis. Table 3 below shows data location numbers for scaling.

Table 3 : Data location number for scaling

Set Items	Channel 1	Channel 2	Channel 3	Channel 4
Digital input values corresponding to upper limit values in the output signal range	520	530	540	550
Digital input values corresponding to lower limit values in the output signal range	521	531	541	551

Figure 15 and Figure 16 shows the rung 2 and rung 3 for ball valve program and butterfly valve program, respectively.

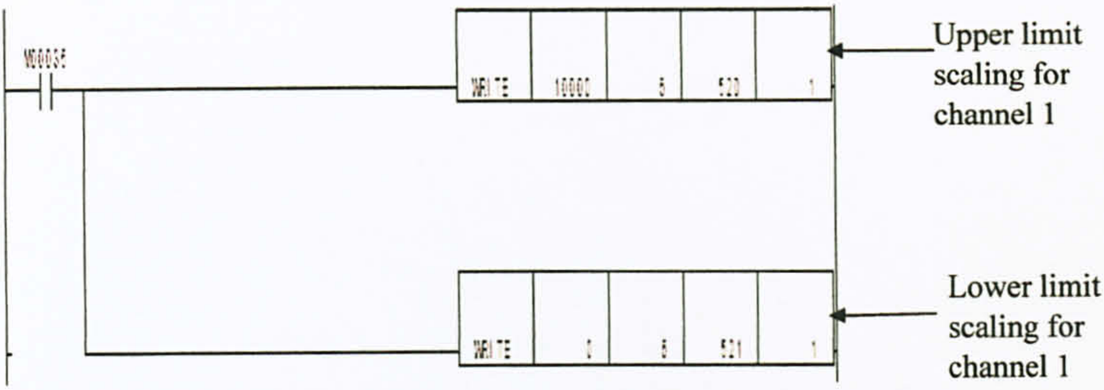


Figure 15 : Rung 2 and 3 for ball valve program

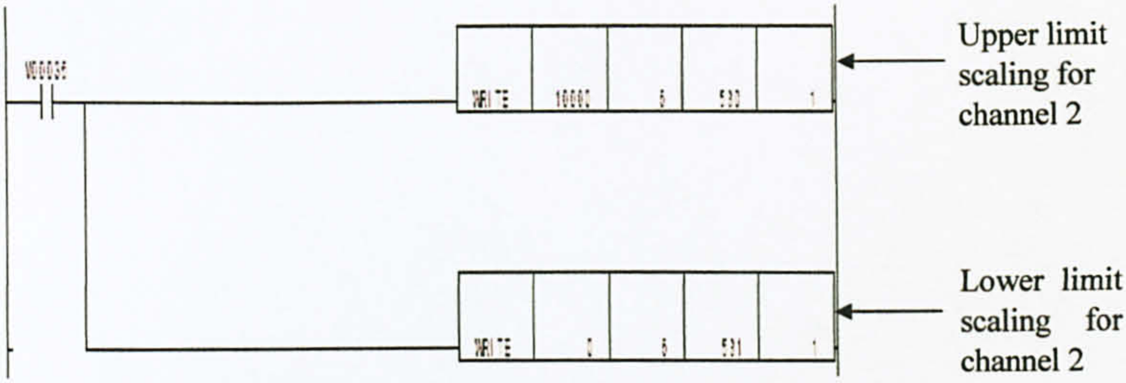


Figure 16 : Rung 2 and 3 for butterfly valve program

The special relay M0035 used in the rung 1, 2 and 3 has a specific function which is to indicate operation and error states of the CPU. This special relay also enables 1 scan when operation is started.

3.2.1.3 Data Input

Data register D0001 is being used in this rung 4, both for ball valve and butterfly valve. Channel 1 is use for butterfly valve for input signal ranging from 1V to 5V. And Channel 2 is used for butterfly valve. Figure 17 and Figure 18 show the rung 4 for both ball valve program and butterfly valve program respectively.

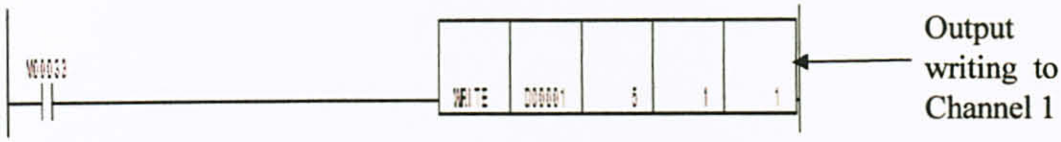


Figure 17 : Rung 4 for ball valve

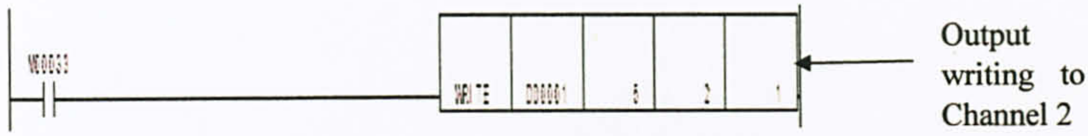


Figure 18 : Rung 4 for butterfly valve

The special relay, M0033 is used to initialize the program and give a permanent high level (always ON).

3.2.1.4 Function IV – Execution of Program

Internal Relay I0002 is being used in rung 5 to shift the lower limit value of output signal (0) to the data register before which is D0001. By forced reset the I0002, 4mA input will be sent to the valve positioner to open the valve 100%.

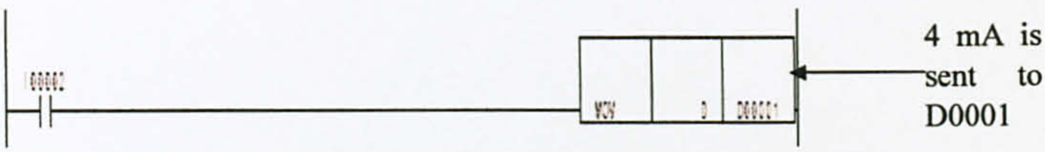
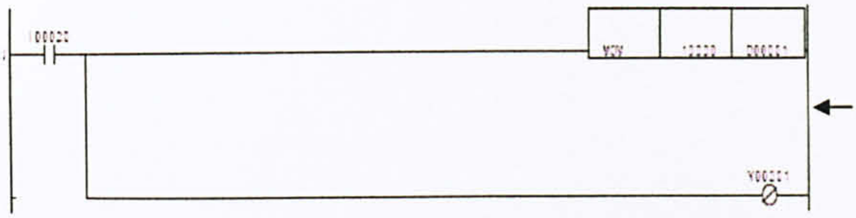


Figure 19 : Rung 5 for ball valve

For rung 6, Internal Relay I0020 is being used to shift the upper limit of output signal (10000) which is 20mA to the Data Register D00001 by **forced reset** it. The solenoid valve will be de-energized and the valve will be closed. However by **forced set** this Internal Relay I0020, the upper limit of output signal will be shift out of the register D00001 and the valve will be travel to 100% opening. The full ladder logic diagram for both ball valve and butterfly valve is attached in APPENDIX B and APPENDIX C respectively.



20mA is sent to D0001 and de-energizing the solenoid valve

Figure 20 : Rung 6 for ball valve

3.3 Hardware and Software Required

3.3.1 Hardware

i. Valves Assembly

There are 2 types of valves that been used for each three vendors which are ball valve and butterfly valve. Table 4 below shows the general specification of each valve used. And Figure 21 shows the arrangement of each valve in the lab 23-00-06.

Table 4 : Specification of each valves used

Manufacturers	Valves	Size (inch)	Input	Minimum Pressure (psi)	Operational Temperature (°C)
FISHER	Ball	6	24 VDC	5 psi	-40 – +80
	Butterfly	3	4-20 mA	5 psi	-40 – +80
METSO	Ball	6	4-20 mA	36 psi	-40 – +85
	Butterfly	4	4-20 mA	36 psi	-40 – +85
MASONEILAN	Ball	6	24 VDC	3 psi	-40 – +85
	Butterfly	6	4-20 mA	3 psi	-40 – +85

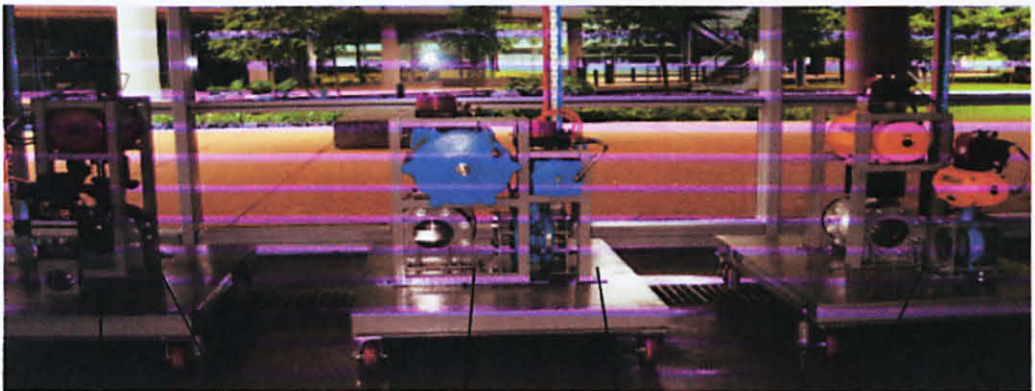


Figure 21 : Valves arrangement for this project

ii. Yokogawa FA-M3 Controller

For this project, the PLC that been used is FA-M3 Controller manufactured by Yokogawa. Table 5 shows the specification of Yokogawa FA-M3 and Figure 22 shows the structure of the PLC.

Table 5 : Specification of the Yokogawa FA-M3 Controller

	Item	**Specifications**
1	Supply Voltage	24 VDC
2	Leakage Current	-
3	Operational Temperature	0 - +55°C
4	Operating environment	Free of corrosive and flammable gases, or heavy dust
5	Cooling Method	Natural-air cooled

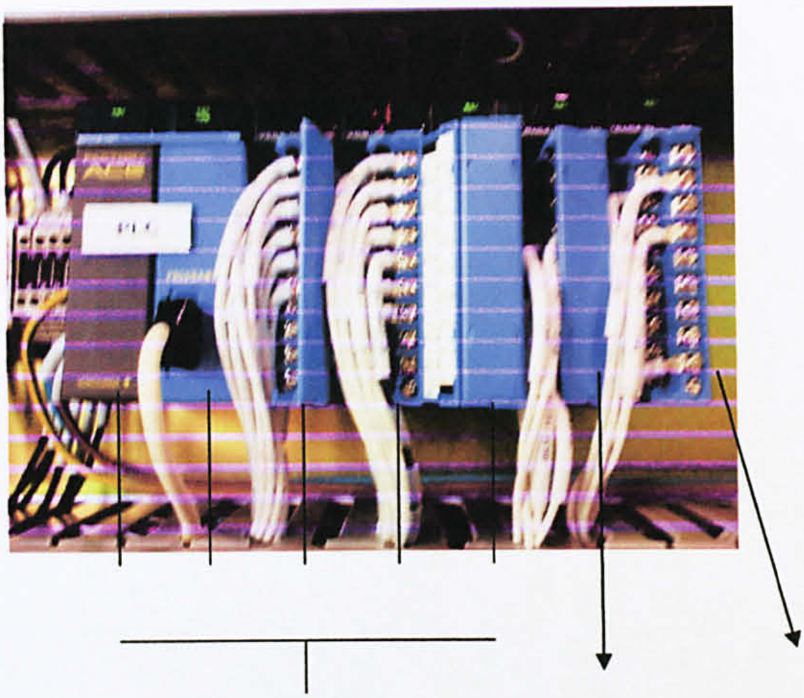


Figure 22 : The structure of the Yokogawa FA-M3 Controller

iii. LC 340 (Line Conditioner)

This LC 340 Line Conditioner is a device that purifies a direct current voltage. For this project, This LC 340 is being used to purify the 24VDC before the signal goes to the FISHER ball valves positioner DVC 6000.

iv. HART Multiplexer

For this project, there is only a PC. Thus for the controller/CPU to choose which valve to be run at the time, it uses the multiplexer to select the valves.

v. Personal Computer

vi. 24 VDC Power Supply

vii. ADAM Converter (Rs485 to USB)

viii. Instrument Air Pressure supply

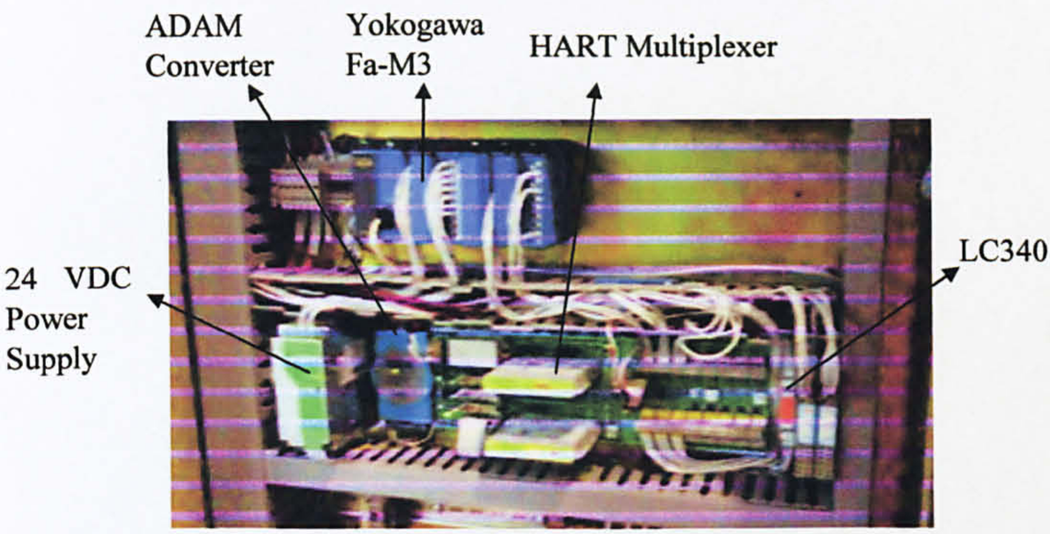


Figure 23 : The arrangement of the devices in the cabinet

3.3.2 Arrangement for the ball valve system

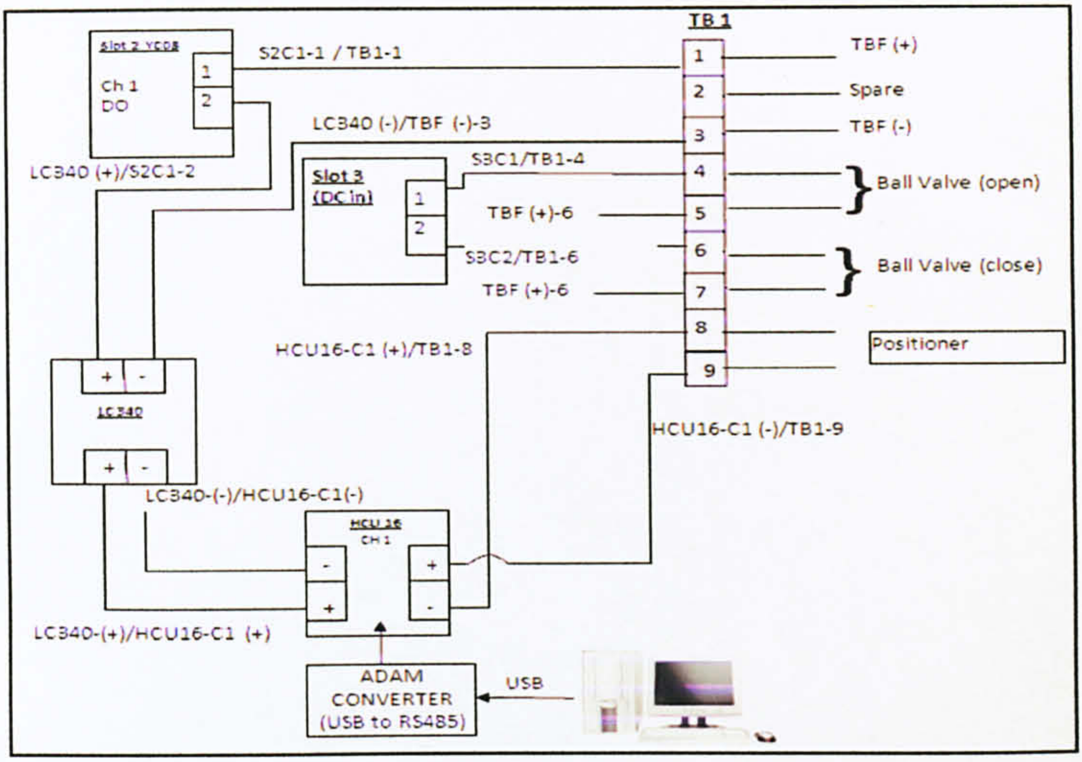


Figure 24 : Line tracing for the ball valve system.

As we can see from Figure 24, there only 2 wires connected to the valve specifically to the DVC 6000 positioner as per stated in Chapter 2. The user input coming from the PC will go through the ADAM Converter and then to the HART Multiplexer (HCU 16). In the HART Multiplexer there are 2 side of connection which is one to the **system** (left side of the HCU 16 in the Figure 27 connected to Digital Output, DO) and the other one is from **field** which is to the valves (right side of the HCU 16 in the Figure 24 connected to the positioner).

This 2-wire configuration without SOV can be a digital or analog input. However for this installation at FISHER ball valve is using digital output. This can be assured by tracing the line from the system side (left side as per Figure 24) of the HART Multiplexer (HCU 16) which is connected to Digital Output.

3.3.3 Arrangement for the butterfly valve system

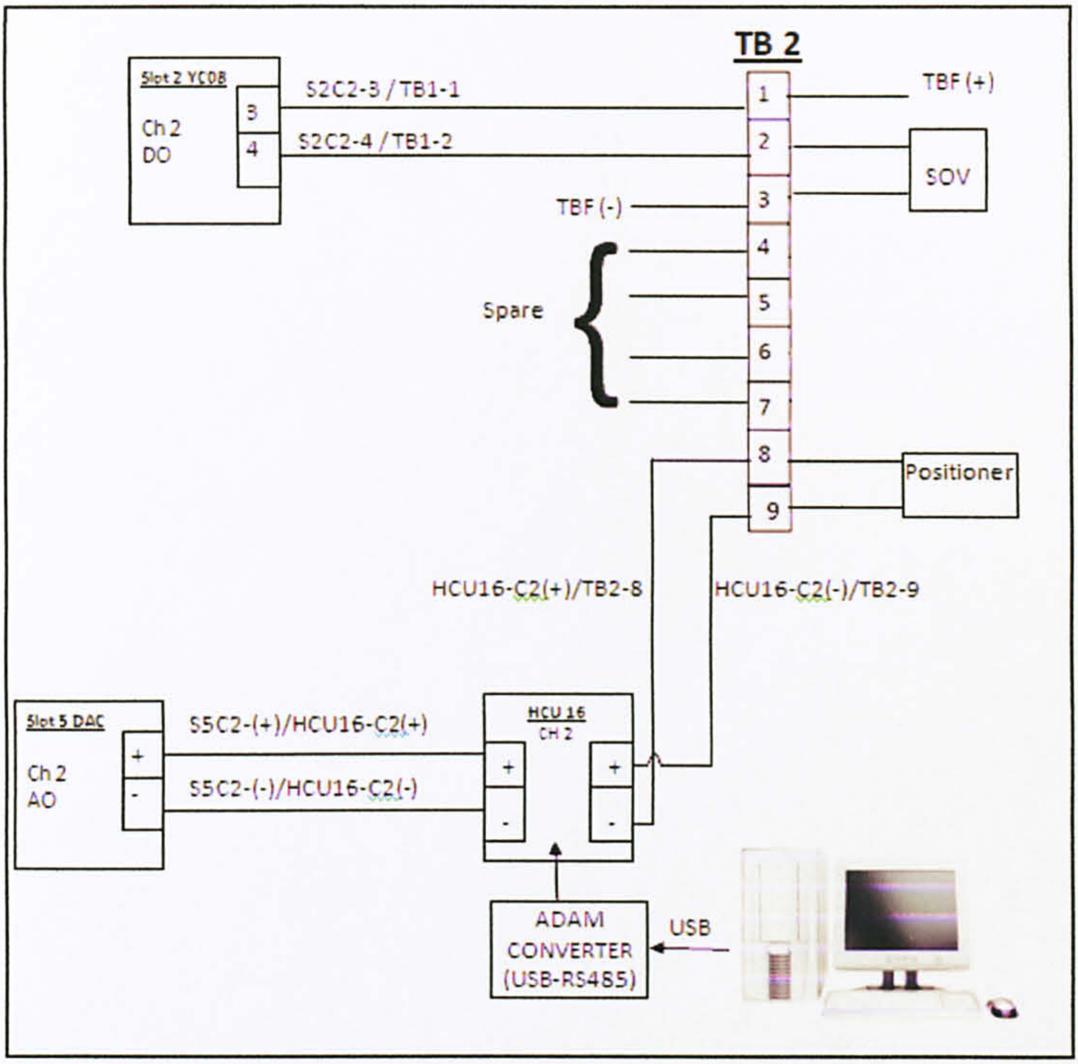


Figure 25 : Line tracing for the butterfly valve system.

Figure 25 shows the line tracing for the butterfly valve system which is using 4-wire configuration. And for this installation, the input is analog 4-20mA from the Slot 5 DAC (Digital to Analog Converter) module. The DO from Slot 2 is connected to SOV.

3.3.4 Software

There are a few software that are been used for this project. Basically there is software to conduct the PST and the WideField2 to program the PLC. Table 6 show all the software that are been used in this project.

Table 6 : Software used for this project

	Software	**Vendor**	**Application**
1	WideField2	Yokogawa	Yokogawa FA-M3 Controller
2	ValveLink	FISHER	Fisher Ball Valve and Butterfly Valve
3	FieldCare	Metso Neles	Metso Ball Valve and Butterfly Valve
4	Valvue ESD	Masoneilan	Masoneilan Ball Valve and Butterfly Valve

CHAPTER 4
RESULT AND DISCUSSION

4.1 Partial Stroke Testing

The PST has been completed for 90-days, which means each valve has performed 450 times PST and 90 times PST collides with FST. Figure 26 shows the valve signature of a successful PST executed on 27th October 2009. (Refer to Appendix D for full report (AMS ValveLink generated) on PST).

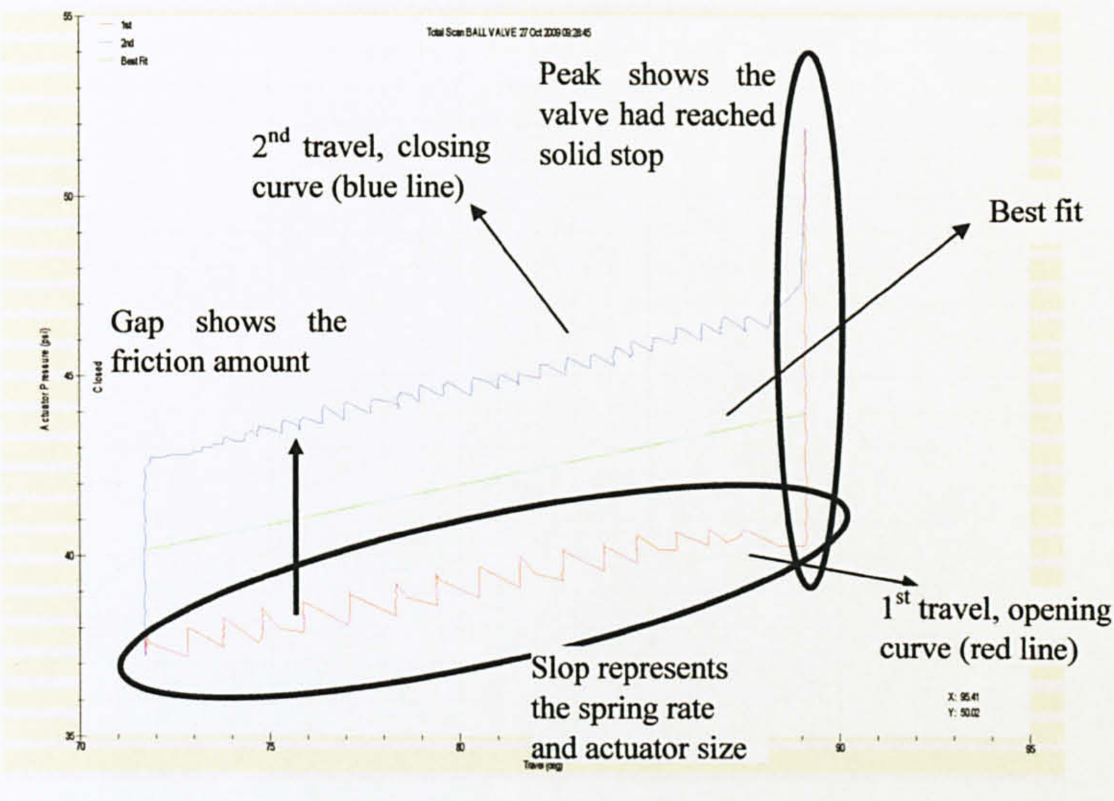


Figure 26 : Valve signature for ball valve.

The y-axis is for pressure and x-axis is for travel. The valve is initially at the operating condition which is at 100% open and equivalent to 90 degrees and it set to partially close up until 80% which is about 72 degrees.

As referred to Figure 26, the valve first travels from 90 degrees to 72 degree. At 90 degree the actuator pressure drops abruptly from 52 psi to 40 psi to overcome the static friction which needs much more torque to make the valve moves. In order to perform PST, the actuator needs to bleed out the air continuously up until it reached maximum travel set. At starting point of second travel, the pressure increased from 37 psi to 42 psi. This is due to over come the static friction which needs more torque to get the valve moving. And the most contributor of friction is coming form the packing of the valve. Then the pressure is steadily increased up until 100% open. The green line is the best fit line which is generated from the AMS Valvelink Software. The software calculated from the parameters that have been keyed in for example actuator size, valve size, the bench set and etc.

For any valve signature, there are three points that need to be analyzed. The first one is the peaks at both ends. However as the testing conducted is the PST, there is only one peak at the end of the valve signature. This peak shows the valve had reached the solid stop. And as for Figure 26, the solid stop reached and stay at 52psi.

Second is the difference between the red line (closing curve) and the blue line (opening curve). This difference shows the friction opposing the valve movement in the system. The greater the difference (means the wider the gap) shows that greater friction in the system. For Figure 26, the gap is 8psi.

The third item is the slope of the signature. This slope represent the spring rate and the actuator size. Thus if a travel signature of a valve having a slope, it is using actuator that have spring. However, if the valve system is not using spring actuator, the travel signature will be flat or horizontal, for example the hydraulic actuator.

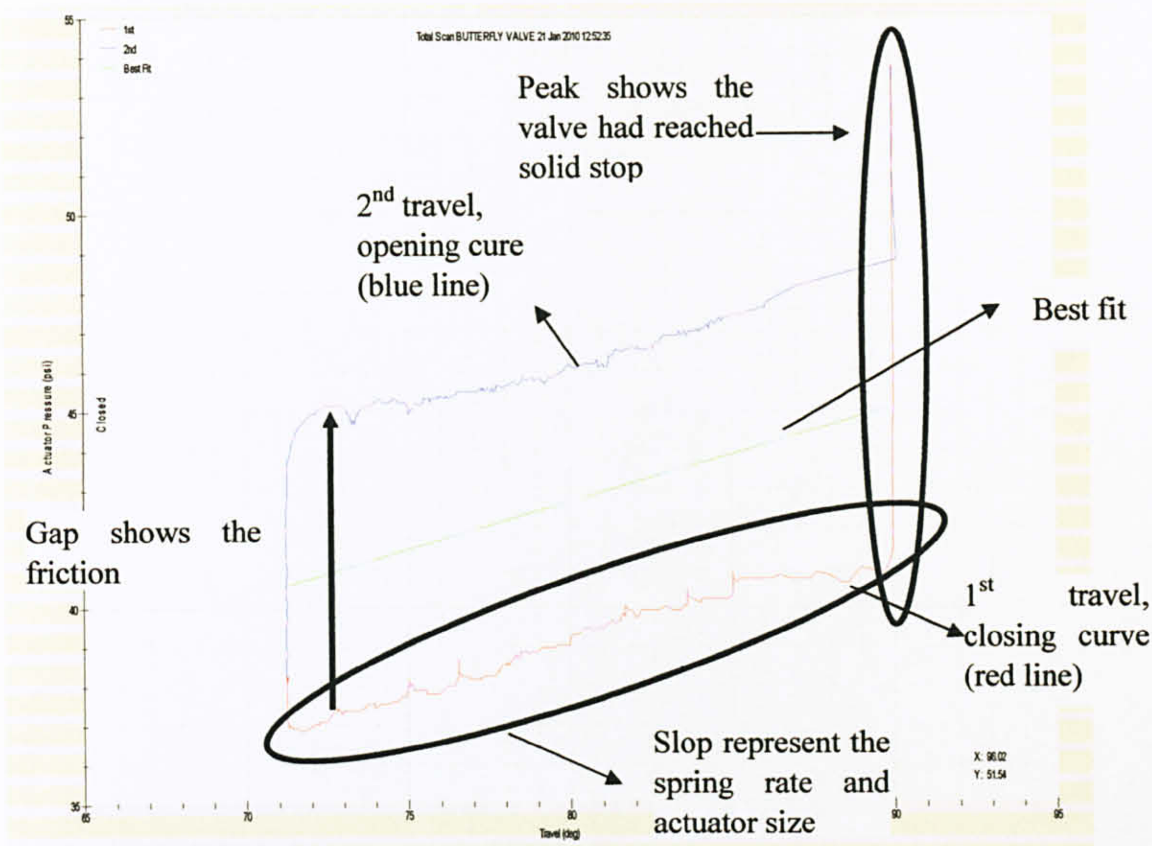


Figure 27 : Valve signature for butterfly valve.

As referred to Figure 27, the pattern is just the same as the signature travel for ball valve. But just a slight different in the numbers of the pressure dropped and pressure increased. And the reason for the hysteresis shape is same and it is because of the friction.

The difference between ball valve system and butterfly valve system obviously is on the size of the valve and thus the actuator. As per discussed before, the effect of actuator size will clearly shown on the slope of the signature. As per Figure 27, the slope different in y-axis is 5psi however for Figure 26 is only 3psi. From that, the smaller the actuator will result in more steeper on the valve travel signature.

4.2 Partial Stroke Testing Coincides with Full Stroke Testing

The signal of FST is given to the valve when the valve is 90% opened during first travel. Figure 28 and Figure 29 show the graph of the testing both for ball and butterfly valve accordingly. Referring to the 90 days of testing data, the entire partial strokes testing which coincides with full stroke testing were failed. The FST take control of the demand. And this is the expected the result.

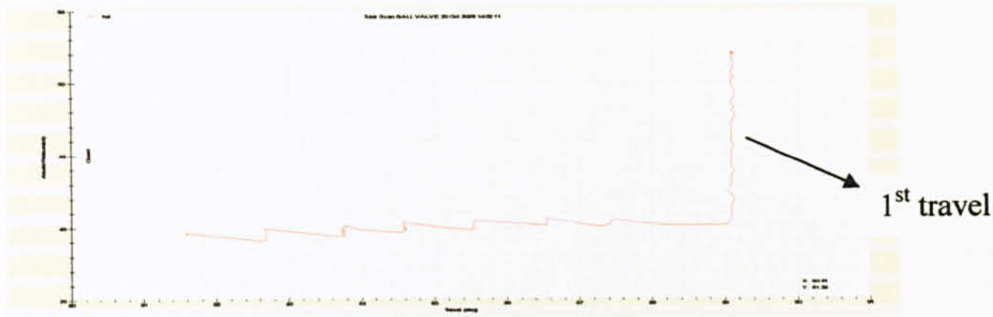


Figure 28 : Graph of PST coincide with FST on ball valve

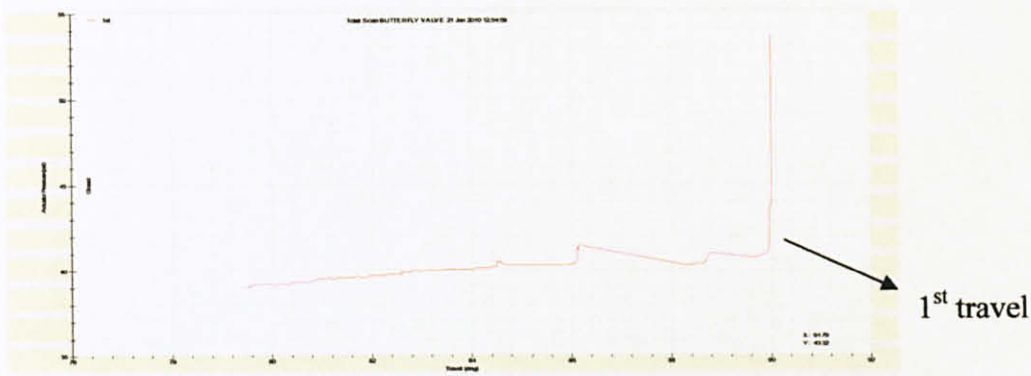


Figure 29 : Graph of PST coincide with FST on butterfly valve

4.3 Analyzed Data of Partial Stroke Testing for Ball Valve

4.3.1 Average Dynamic Error

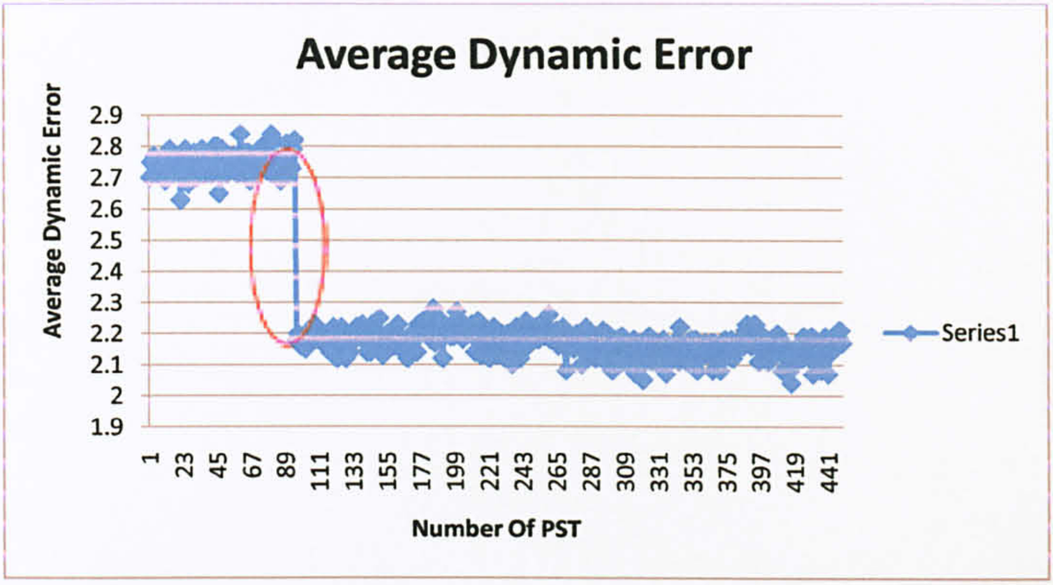


Figure 30 : Average Dynamic Error versus Number of PST

4.3.2 Minimum Dynamic Error

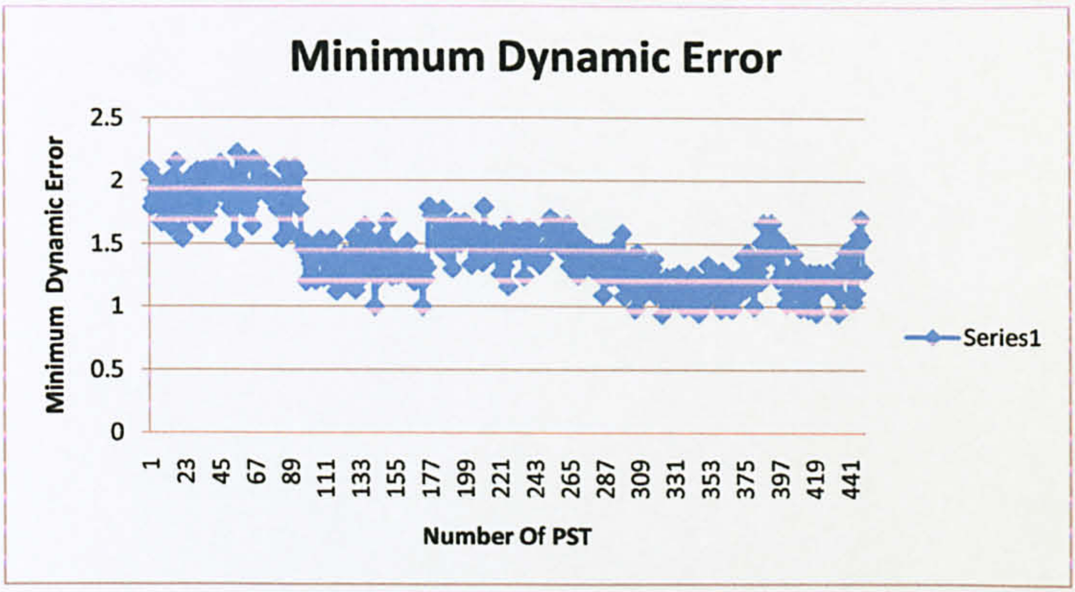


Figure 31 : Minimum Dynamic Error versus Number of PST

4.3.3 Maximum Dynamic Error

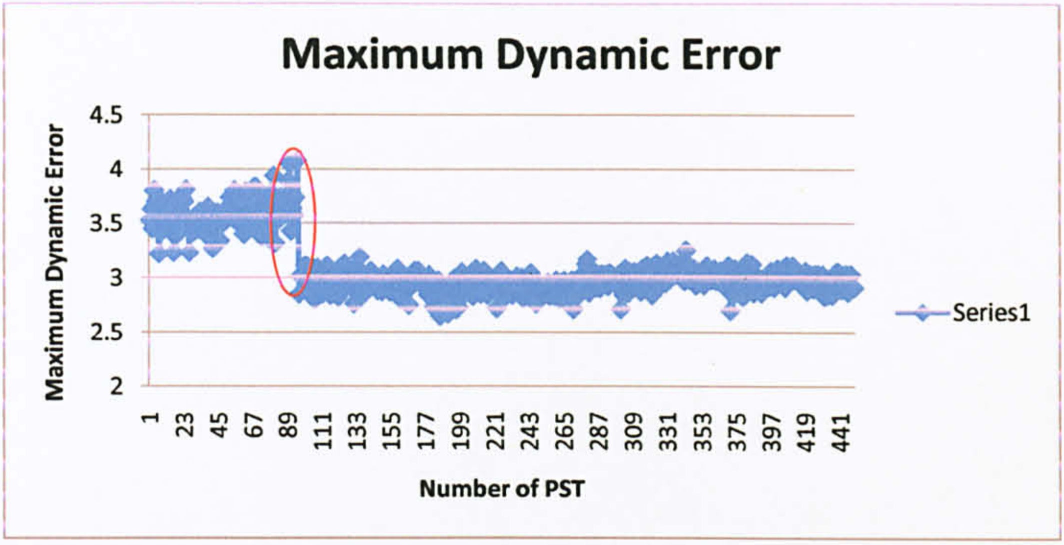


Figure 32 : Maximum Dynamic Error

AMS ValveLink software analyzed the dynamic error curve from 5% travel to 95% travel and calculates the average, maximum and minimum difference between opening and closing curves. Referrring to Figure 30, the plot shows that initially the valve Average Dynamic Error was around 2.75%. After the 95th testing (red circle), the Average Dynamic Error reduced to around 2.25% in total reduced to 0.5% error. For the Maximum Dynamic Error, the reading was reduced from 3.7% to 3.1% as shown in Figure 32. This happened because previously, the DVC output was connected to the solenoid and the solenoid was connected to the actuator. During the operation, the DVC has a restriction when air goes through the solenoid and to actuator. After removing the solenoid, the output of DVC become smooth where there is no restriction in between the actuator and the DVC

4.3.4 Dynamic Linearity

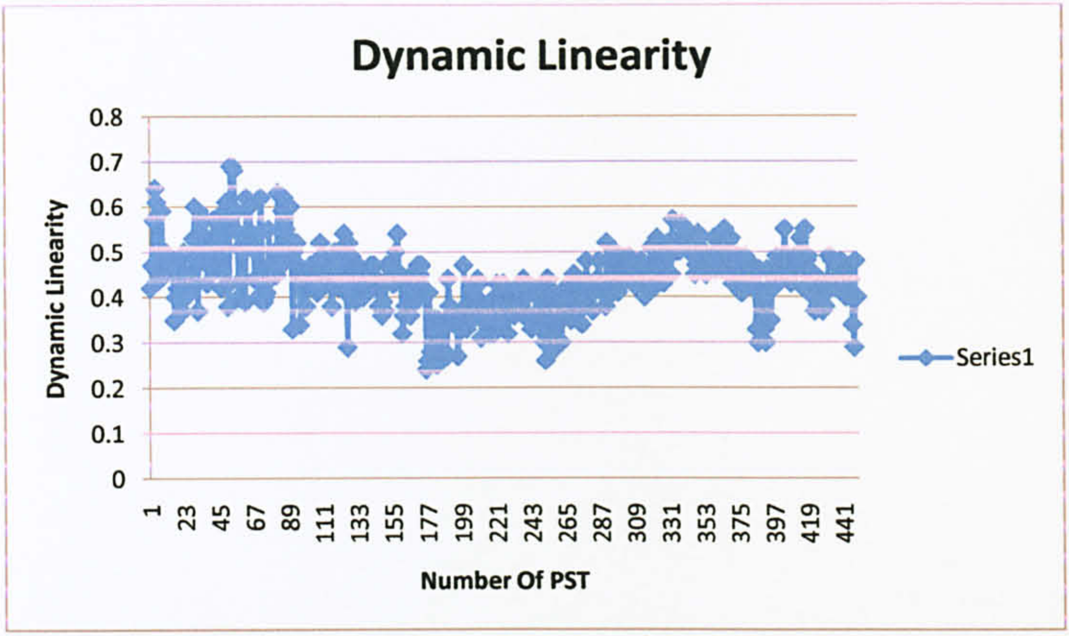


Figure 33 : Dynamic Linearity versus Number of PST

Linearity is the maximum deviation from a straight line best fit to the opening and closing curve and line representing the average value of those curves. Based on Figure 33, the Dynamic Linearity varies along the number of PST executed and does not affected by the removal of solenoid.

4.3.5 Zero Ranged Travel

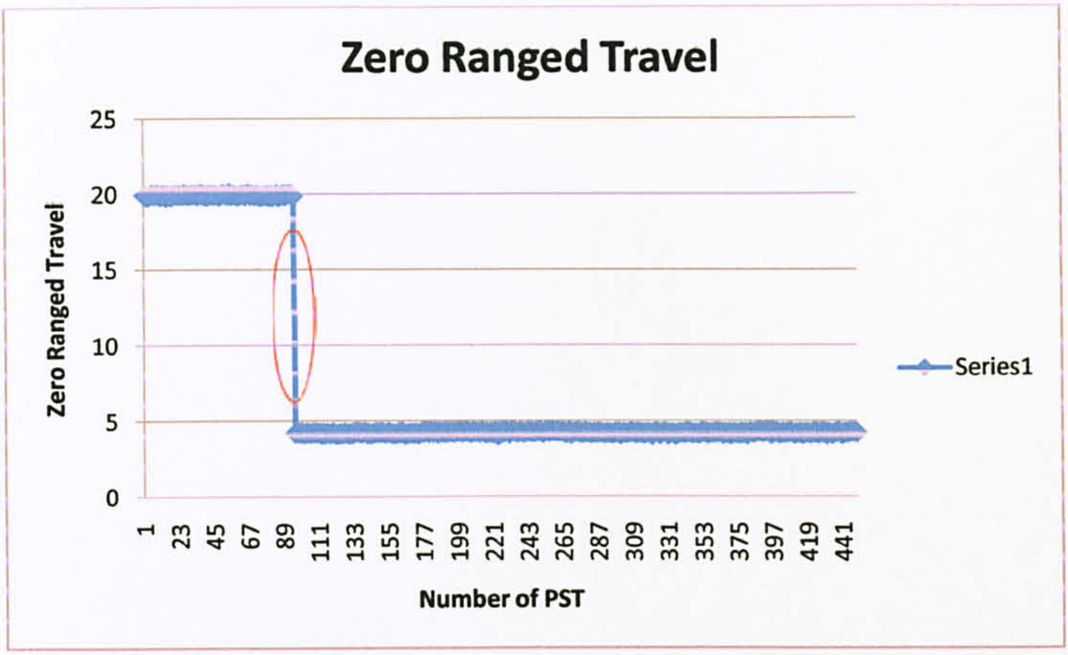


Figure 34 Zero ranged Travel versus Number of PST

AMS ValveLink Software establishes a best fit line through the Dynamic Error Band and projects this to a ranged travel of zero. It converts the X-axis point where the ranged travel is zero, from input percent to milliamps (mA). The Zero Ranged Travel was ranging from 19.92mA to 20.04 mA. Referring to Figure 34, at 95th PST the values were dropped to 4.21 mA and continued up until the end. This drop was due to the changed of operating mode from analog to digital. Initially, the valve was configured at zero ranged valve opens. This is only applicable for Relay Type B special. This relay has been removed when the solenoid was bypassed and being replaced by Relay Type A. For Relay Type A, it is configured that valve close when zero power condition occurred. Therefore, the 4~20 mA signal changed at the plot.

4.3.6 Full Ranged Travel

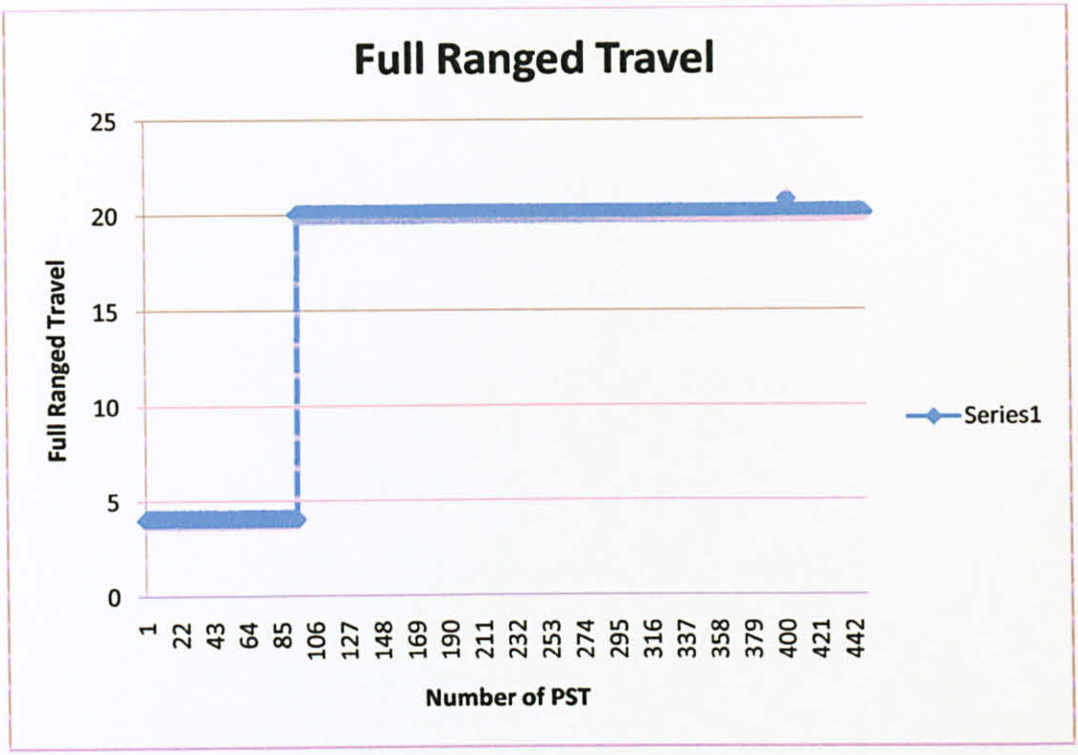


Figure 35 : Full Ranged Travel versus Number of PST

Full Ranged Travel is the point where the travel no longer increases with an increase in current. There was a sudden rise at 95th PST as shown in Figure 35. Previously, the Zero Power Condition was set the valve to open when power fails. After changing the operation mode of the valve (from analog operated to digital), the Zero Power Condition is set to close which cause the valve to fully close when power fails. Initially, at full range the valve was configured closed position. After changing the setting of Zero Power Condition, the valve goes to open position as it is configured as open at full range.

4.3.7 Lower Bench Set

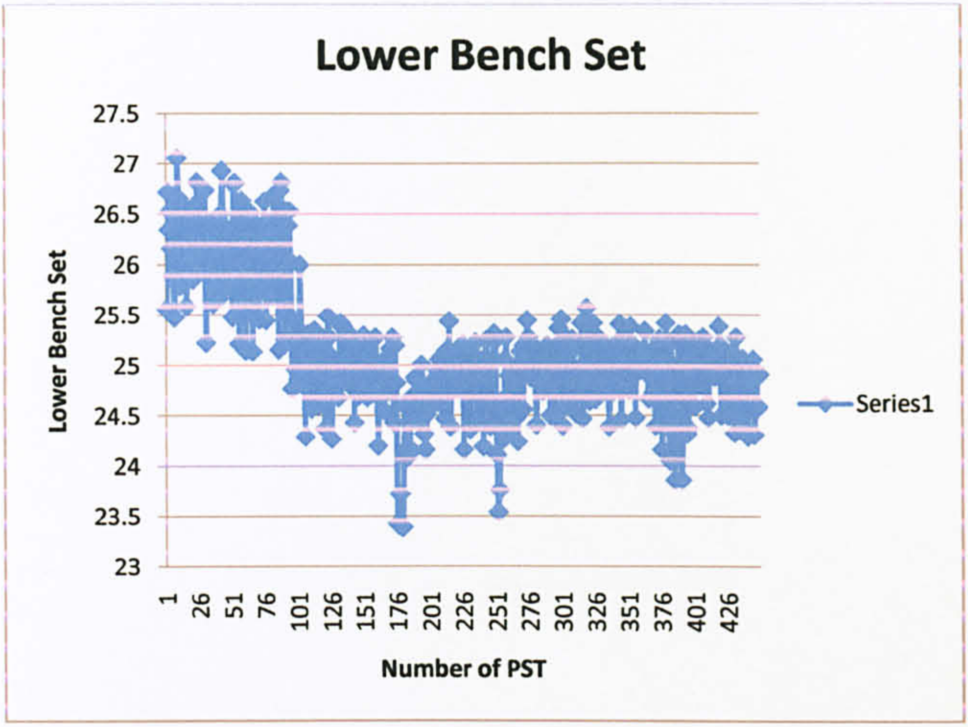


Figure 36 : Lower Bench Set versus Number of PST

4.3.8 Upper Bench Set

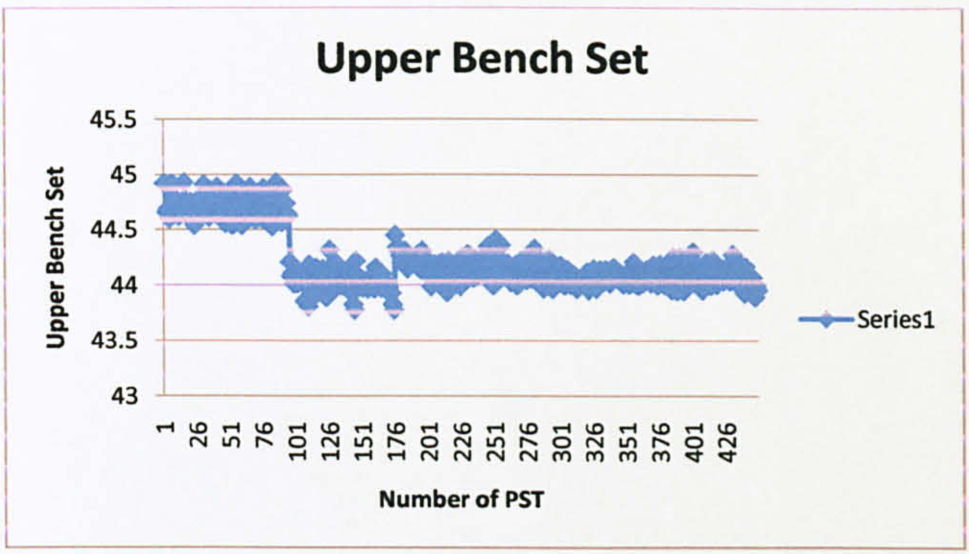


Figure 37 : Upper Bench Set versus Number of PST

Lower Bench Set is the amount of pneumatic pressure required to begin actuator movement. Figure 36 and 37 show that the pressure reading is reduced after 95th PST. Upper Bench Set displays the amount of pneumatic pressure required to drive the actuator through the full range of travel. Note that the pressure required to moving the valve is also reduced after 95th PST. The valve requires less pressure to move from its seat when the solenoid is bypassed. Previously, the pressure is supplied to both solenoid valve and DVC to operate the valve. After bypassing the solenoid valve, the pressure is only supplied to the DVC.

4.4 Analyzed Data of Partial Stroke Testing for Butterfly Valve

4.4.1 Average Dynamic Error

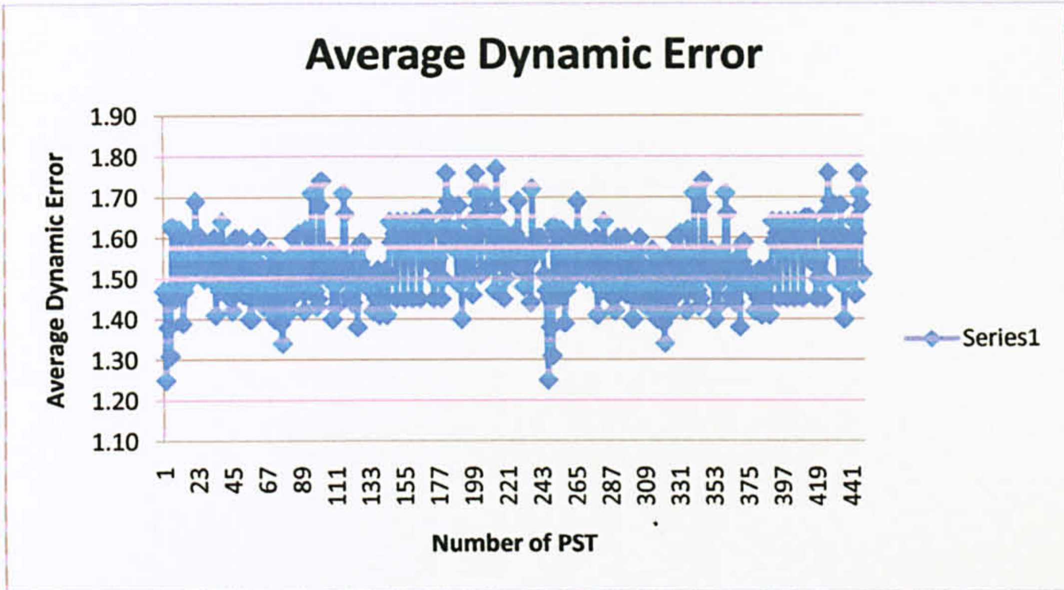


Figure 38 : Average Dynamic Error versus Number of PST

Dynamic Error Curve is the difference between opening and closing curve from 5% to 95% of valve travel. From the curve, the AMS ValveLink software calculates the average, maximum and minimum difference of the opening and closing curve. The graphs are plotted to observe the differences and its effect to the valve. Figure 38 shows the Average Dynamic Error plot which ranging from 1.2% to 1.8%. With 0.6% variation, the graph is acceptable.

4.4.2 Minimum Dynamic Error

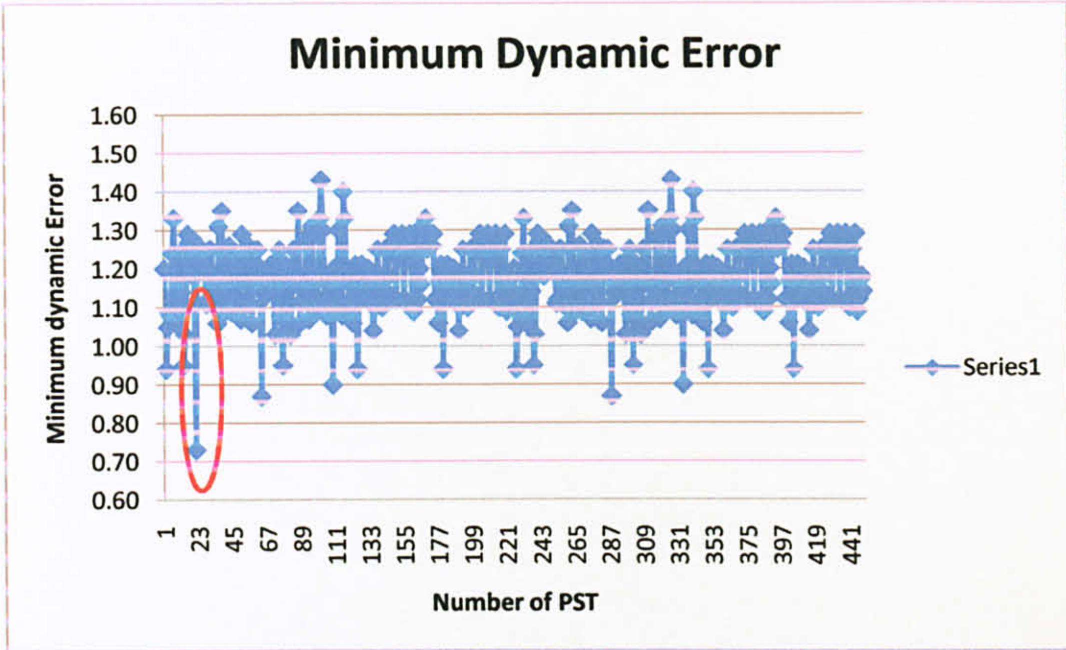


Figure 39 Minimum Dynamic Error versus Number of PST

Figure 39 shows the Minimum Dynamic Error graph of PST. The variation is ranging from 0.9% to 1.7%. The spike at 21st PST is 0.73%. Tightening valve packing cause one of the minimum dynamic error overshoot.

4.4.3 Maximum Dynamic Error

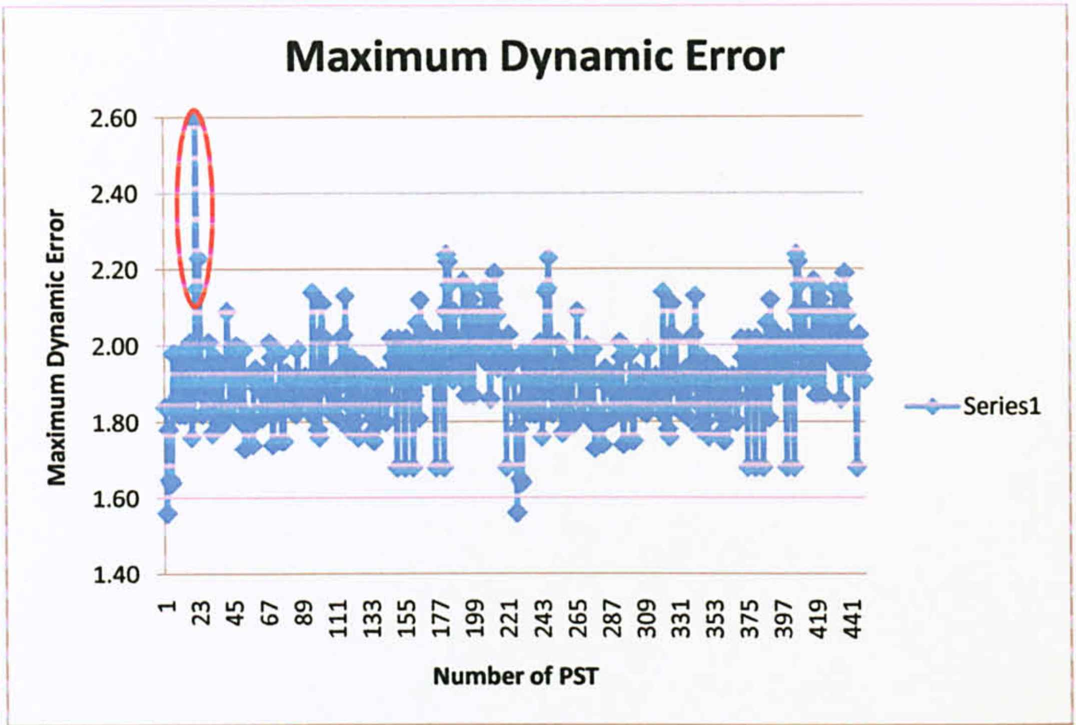


Figure 40 : Maximum Dynamic Error versus Number of PST

Figure 40 shows the Maximum Dynamic Error graph of PST. The variation is ranging from 1.5% to 2.2%. At 21st PST, the value is 2.59% which is out of ranged. This is due to tightening the valve packing activity about quarter turn. Tightening the gland packing of the valve requires more pressure to move the disc from its seat.

4.4.4 Dynamic Linearity

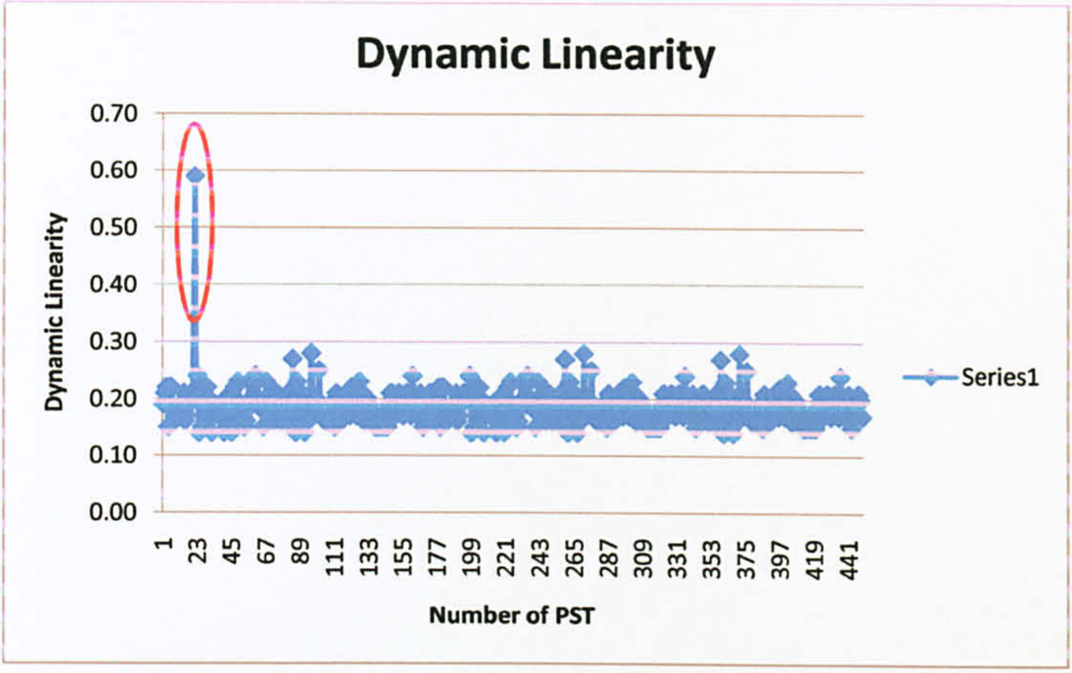


Figure 41 Dynamic Linearity versus Number of PST

Figure 41 shows the Dynamic Linearity graph. Linearity is the maximum deviation from a straight line best fit to the opening and closing curves and a line representing the average value of those curves. The readings are ranged from 0.1% to 0.3%. Tightening the valve packing causes the value of dynamic linearity at 21st PST to be out of range.

4.4.5 Zero Ranged Travel

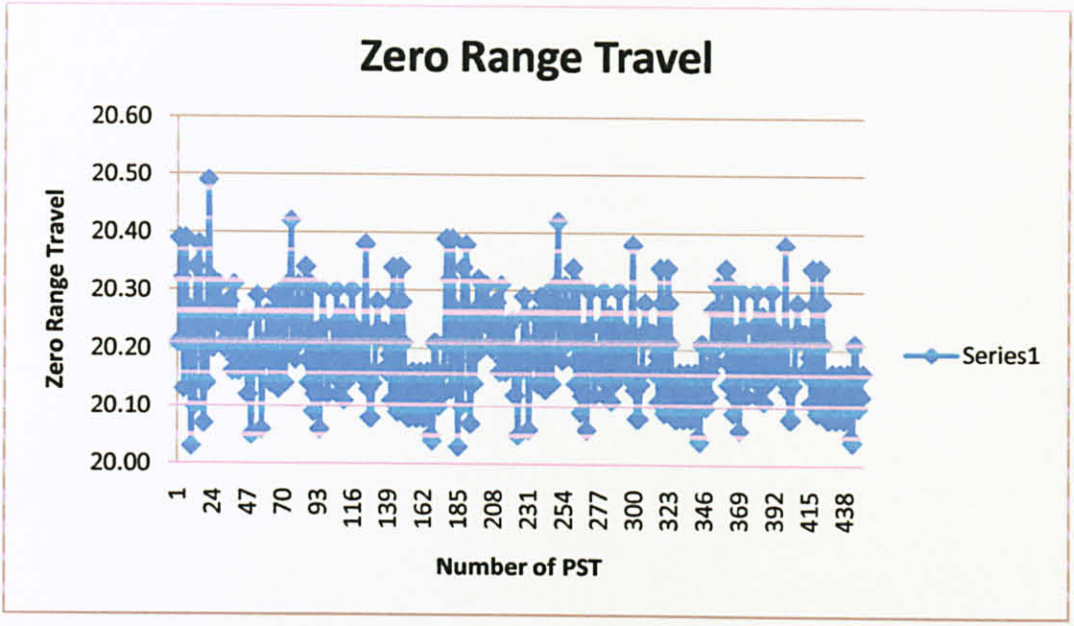


Figure 42 : Zero Ranged Travel versus Number of PST

Using the Dynamic Error Band, the AMS ValveLink software establishes a best fit line and projects this to a ranged travel of zero. AMS ValveLink Software converts the X axis point of dynamic band graph where the ranged travel is zero, from input percent to milliamps. Referring to Figure 42, the Zero Range Travel is ranging from 20mA to 20.5 mA. The reading at 21st PST is the highest among all due to tightening the valve packing.

4.4.6 *Full Ranged Travel*

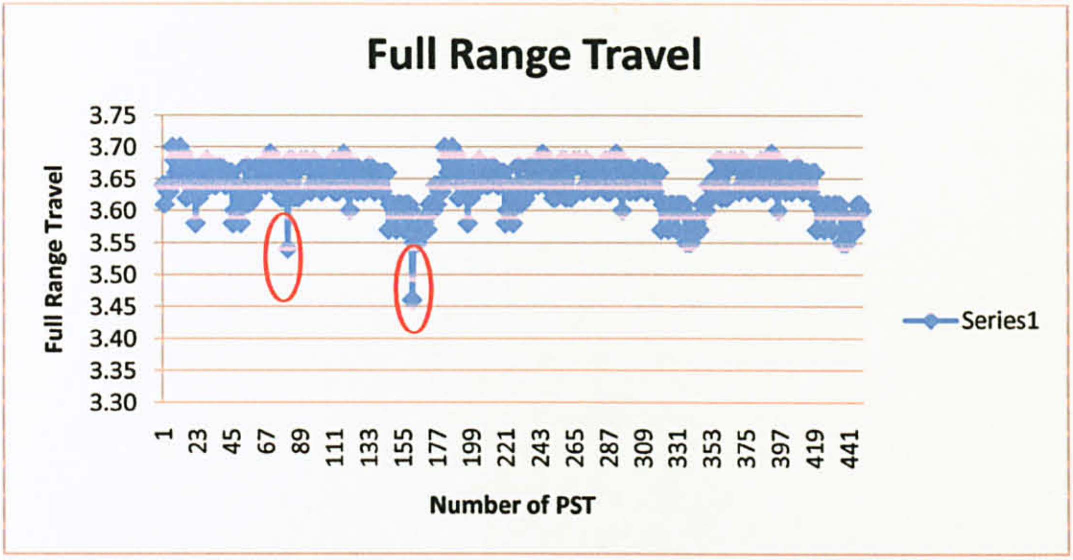


Figure 43 : Full Ranged Travel versus Number of PST

Full Range Travel is the point where the travel no longer increases with an increase in current. The value of full range travel is between 3.5mA to 3.7mA. At 81st and 161st PST, the value is out of ranges which are 3.54 mA and 3.46 mA, respectively as shown in Figure 43.

4.4.7 Lower Bench Set

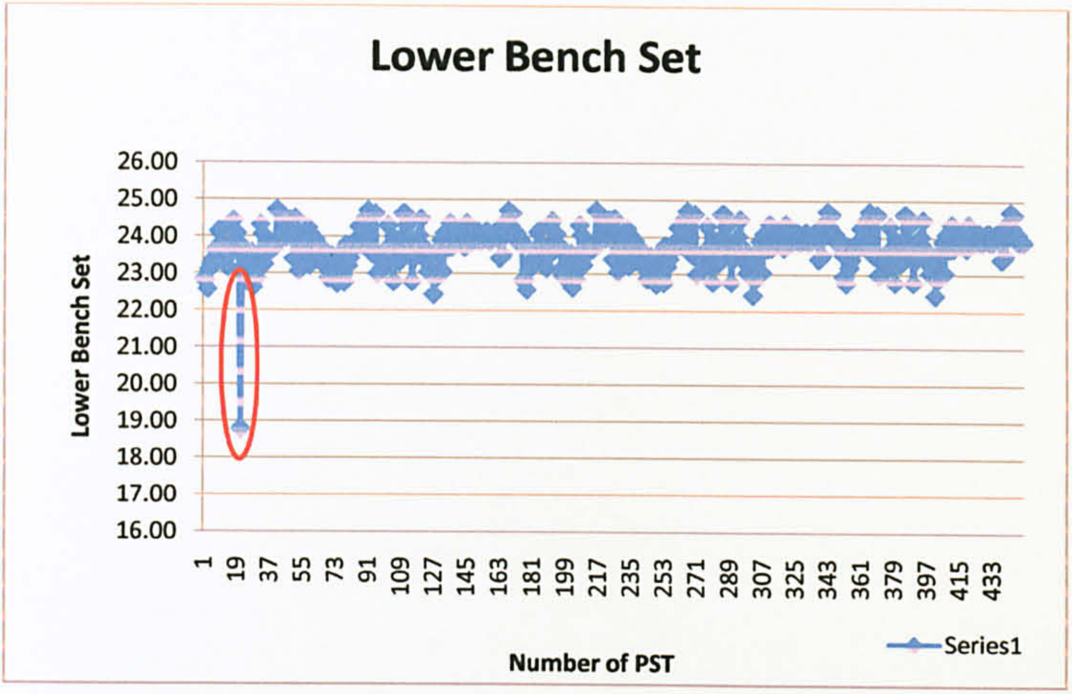


Figure 44 : Lower Bench Set versus Number of PST

Figure 44 shows the Lower Bench Set plot. Lower Bench Set is the amount of pneumatic pressure required to begin actuator movement. The reading is ranging from 22 psi to 25 psi. The overshoot occurred at 21st PST due to tightening the valve packing.

4.4.8 Upper Bench Set

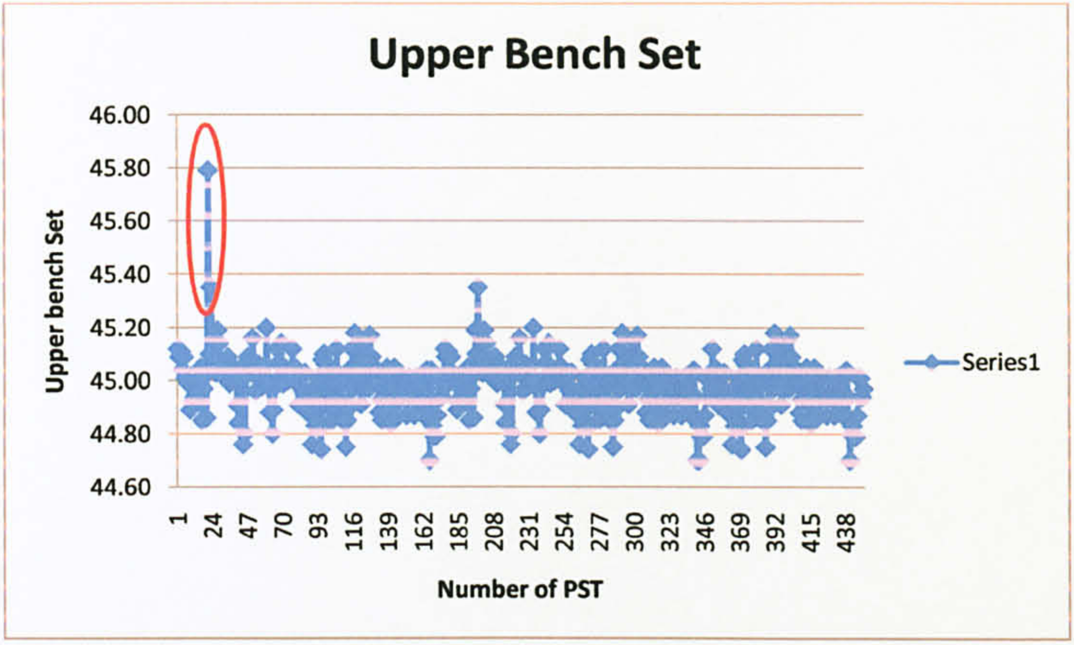


Figure 45 : Upper Bench Set versus Number of PST

Upper Bench Set displays the amount of pneumatic pressure required to drive the actuator through the full range of travel. The reading ranges from 44.6 psi to 45.2 psi which varies about 0.6 psi. Figure 45 shows the overshoots occurred at 21th PST due to tightening the valve packing activities.

4.5 Established Procedure PST for FISHER

As one of the objectives of this project, the procedure to conduct PST in the UTP lab for FISHER system had been established. The procedure developed considered veteran users whom may not a computer literate and it is very detail. The procedure than had been revised by GTS person in charge. The full detail procedure is attached in the APPENDIX D cause it consists too many pages.

4.6 The Mini Process Plant Design For Phase II

4.6.1 First Design

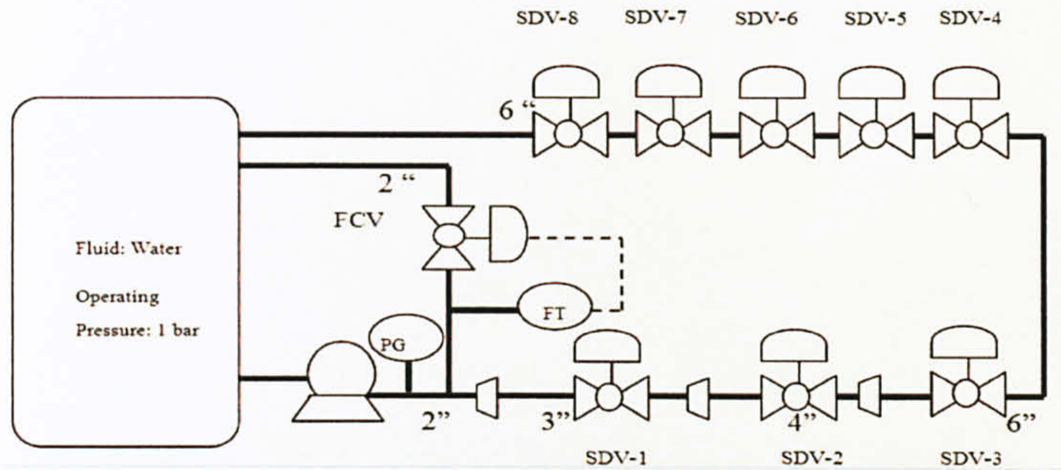


Figure 46 : Process flow of the mini process plant

Figure 46 shows the process flow of the mini process plant. However this is the first design and many factors need to be considered. This design basically wants to allow the fluid passing through to the all valves. Some factors that have been highlight and have been taken care for the better design are:

1. Bypass line for all valves because if one of the valves is cannot be operated, the PST can still be continued.
2. The position of the valves whether to have an increasing diameter pipeline size or decreasing diameter pipeline size because it will effect the process operating pressure.
3. Piping material that has been chosen is PVC. The problem is can PVC pipe withstand the operating pressure which is 1 bar.
4. Pump rating and type of pump.
5. The different size of valves used in this project. Thus reducers need to be used. Thus how much pressure drop for each reducer should be taken care.

4.6.1.1 Second Design

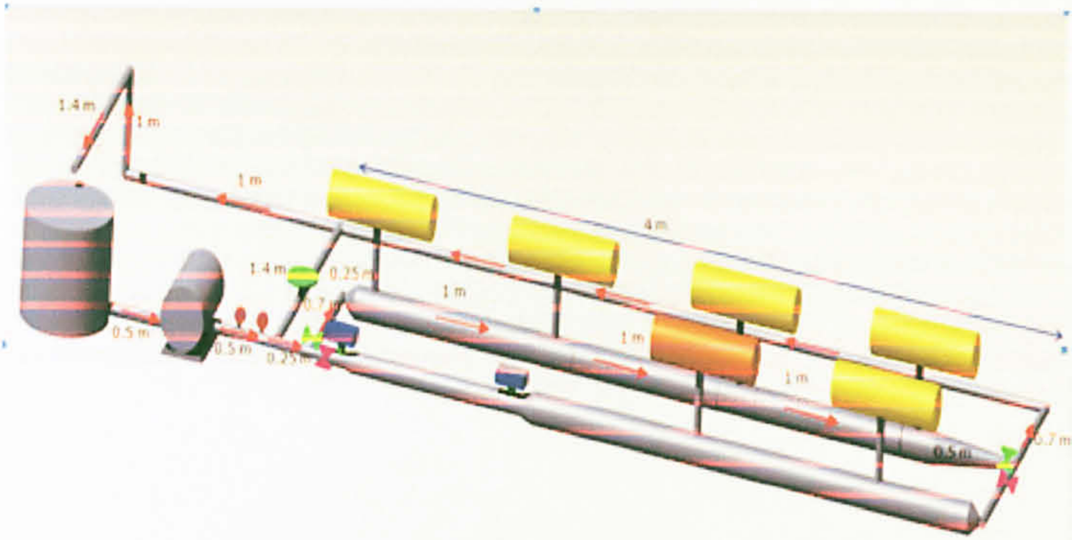


Figure 47 : Update design of the PST test rig with flow

This design then was created. The better specification of this design than the first design is that:

i. The water will not flow only in one path. For maintenance wise, it is easier because if using one single path, only one of the valve is out of service, it will effect all the other valves.

ii. Less cost.

iii. Easier for installation.

In addition, for this design, the tank size (radius and height) and the pump capacity has been calculated. The detail calculation is as below and referred to Figure 47 above.

Design Objective:

To proposed the tank size and the pump capacity. To proposed the layout in 3-D.

Description:

Initially is to estimate the biggest volume flow of the piping. This must be known because we want to calculate the required size of the tank. The biggest volume will be the flow through the four 6" valves. Using the known information about the size of valves, and the assumption to use a 45 liter/min pump (available commercially), the proposal is to have the size of the tank (r=radius and h=height) to be **r=0.25m** and **h=1m**. The calculation is as below.

Detail Calculation:

<u>Volume for 2" pipe diameter</u>

$r = 1" = 0.0254$ m

$l = 0.5 + 0.5 + 0.25 + 0.7 + 0.7 + 4 + 1 + 1.4 + 1 = 10.05\text{m}$

$A = \pi r^2 = \pi(0.0254)^2 = 0.00203\text{m}^2$

$V = Al = 0.00203x10.05 = 0.0204\text{m}^3$

<u>Volume for 6" pipe diameter</u>

$r = 3" = 0.0762$

$l = 3.75$

$A = \pi r^2 = \pi(0.0762)^2 = 0.01824m^2$

$V = Al = 0.01824x3.75 = 0.0684m^3$

$V_{total} = V_{2"} + V_{6"} = 0.0204 + 0.0684 = 0.0888m^3$

The output discharge of the available pump is $45\, {}^{l}/_{min} = 0.045\, {}^{m^3}/_{min}$

$\therefore Volumetric\ flow\ rate, \dot{V}$

$$\dot{V} = \frac{V}{t}$$

$$t = \frac{V}{\dot{V}} = \frac{0.0888}{0.045} = 1.97min = 118.4s \approx 120s$$

$t_{testing} = 80s$

#Total time required $= t + t_{testing} = 120 + 80 = 200s = 3.333min$

$\therefore$ *minimum volume tank required*

$= V_{piping} = 0.045\ m^3/min \times 3.333min = 0.15m^3$

#Note: By using hand valves at beginning and ending of each branch, the ***Total time has been reduced*** since the flow is directed to either of the branches depending on the location of the valve to be tested. This is because only one valve will be tested at one time.

<u>Check back the volume of the tank with the specified *r* and *h*</u>

$$V_{tank} = \pi r^2 h = \pi \times 0.25^2 \times 1 = 0.196m^3$$

Thus the size of the tank is valid because

$$V_{tank} > V_{piping}$$

$$0.196m^3 > 0.15m^3$$

Thus the size of the tank size with radius = 0.25m and height= 1m is reasonable with the output discharge of the pump which is 45 *l*/min and the requirement od the operating pressure which is 1 bar.

4.6.1.2 Third Design

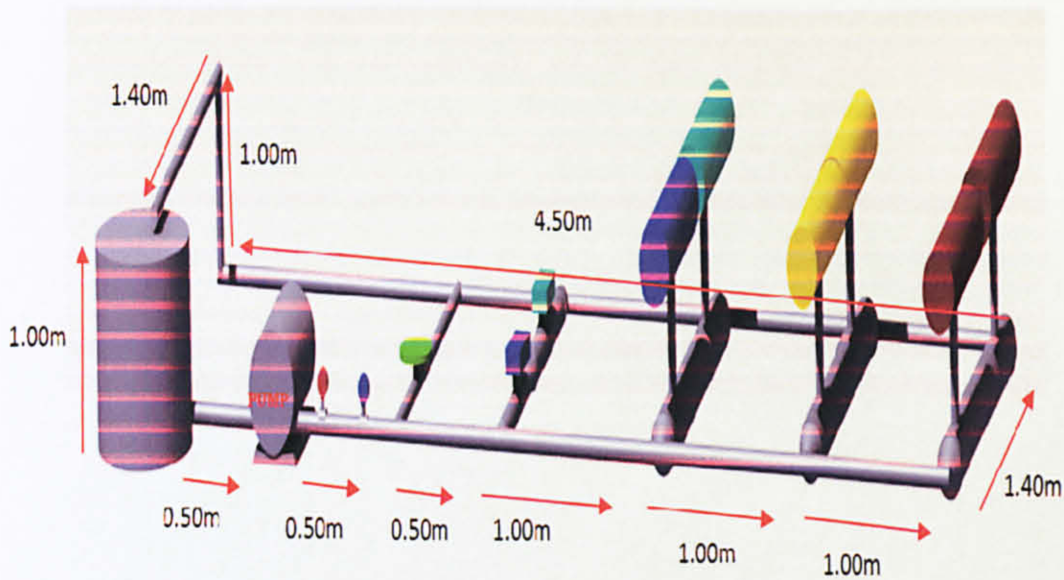


Figure 48 : Approved process design for construction

Detail Calculation:

<u>Volume for 2" pipe diameter</u>

$r = 1" = 0.0254 \text{ m}$

$\text{l} = 0.5 + 0.5 + 0.25 + 0.25 + 3 + 3 + 0.25 + 0.25 + 1 + 2.4 = 11.4 \text{ m}$

$\text{A} = \pi\text{r}^2 = \pi(0.0254)^2 = 0.00203\text{m}^2$

$\text{V} = \text{Al} = 0.00203\text{x}11.4 = 0.023142 \text{ m}^3$

<u>Volume for 6" pipe diameter</u>

$r = 3" = 0.0762m$

$l = (0.35m \; x \; 6) + 1.4 + = 3.5m$

$A = \pi r^2 = \pi(0.0762)^2 = 0.01824m^2$

$V = Al = 0.01824x3.75 = 0.06384m^3$

$V_{total} = V_{2"} + V_{6"} = 0.023142 + 0.06384 = 0.086982m^3$

The output discharge of the available pump is $45 \, {}^{l}/_{min} = 0.045 \, {}^{m^3}/_{min}$

$\therefore Volumetric \; flow \; rate, \dot{V}$

$$\dot{V} = \frac{V}{t}$$

$$t = \frac{V}{\dot{V}} = \frac{0.086982}{0.045} = 1.933min = 115.98s \approx 120s$$

$t_{testing} = 80s$

#Total time required $= t + t_{testing} = 120 + 80 = 200s = 3.333min$

$$\therefore minimum \; volume \; tank \; required = V_{piping} = 0.045 \, m^3/min \times 3.333min = 0.14985m^3$$

<u>Check back the volume of the tank with the specified *r* and *h*</u>

$V_{tank} = \pi r^2 h = \pi \times 0.25^2 \times 1 = 0.1963m^3$

Thus the size of the tank is valid because

$V_{tank} > V_{piping}$

$0.1963m^3 > 0.14985m^3$

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

5.1.1 The comparison of the PST performance of ball valve and butterfly valve

5.1.1.1 Valve Signature of PST

Ball valve requires much more pressure at the beginning of the opening as to compare to butterfly valve. The reason being is because the actuator size and in fact the valves themselves are different in size. The ball valve is bigger than the butterfly valve and so the actuator of the ball valve. Inside the actuator (rack and pinion type), there is a spring to control the movement of the ball or the disk. The spring inside the ball valve's actuator is bigger; hence it needs more torque to cause the valve to move to overcome the bigger static friction which the primary source is at the packing.

5.1.1.2 Bypass the solenoid valve

Bypassing the solenoid valve reduced the pressure supplied to the DVC positioner. The value of dynamic error and bench set proved that the pressure supplied to the ball valve was reduced after removing the solenoid valve from the system. It is because the instrument air can go through the actuator directly from DVC positioner without restriction from the solenoid valve.

5.1.1.3 2-wire system versus 4-wire system

Removing the solenoid valve from the ball valve system make the DVC installation became a 2-wire system which requires less wiring and would reduce cost. In the other hand, the 2-wire system requires the installation of Line Conditioner which could add up again the total cost of the installation.

5.1.2 The performance of PST when it collides with FST

Out of 90 times of partial stroke testing coincides with FST, all of the PST were failed. The reason is the FST take control of the demand. And this is expected result as for real situation if real emergency occurs, the emergency demand should take control of the PST, thus PST should fail.

5.1.3 Mini Process Plant for the Phase II

This Phase II project needs a real flow through the valve. Hence using the available pump in the lab, the size of the tank has been estimated. The output discharge of the pump is 45 *l*/min and the estimated size of the tank is with 1m height and 0.25m radius. The design of the mini process plant has been approved and is being brought for the procurement and next installation process.

5.2 Recommendation

5.2.1 Safety issue

The unsafe condition is the loose connection between the Pressure Regulator and the hand valve at the Instrument Air Supply line. As the Phase II mini plant will be constructed soon, ensure all connection and joint are been tighten properly to prevent any accidents.

The second unsafe condition is very loud noise when the plant in the lab is operated. Thus the users must wear ear protection and the ear protection must be provided sufficiently.

5.2.2 Updated Anti-virus protection for the PC in the lab

Up until today, the PC in the lab cannot detect the valve due to the failure in recognizing the ADAMS Converter. However person in charge from the vendor side (FISHER) together with the author had try to install back the driver of the ADMAS Converter. However the driver cannot be installed because of the driver (the PC cannot recognize the port on which the ADAMS Converter had been plugged to.

5.2.3 2-wire system installation

The result from Phase I show 2-wire system needs less air pressure and resulted in more consistent of the valve travel signature. Thus for the Phase II it is recommended to ensure the installation for both ball and butterfly valve system are same which is 2-wire system with-out solenoid valve.

5.2.4 Conduct HYSIS simulation

HYSIS Simulation is simulation software that can calculate the flow, pressure, level and many other process control parameters. By conducting simulation using this software, a study and investigation can be done to know the pressure at various locations in the plant

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[8] PTS 32.36.01.17

APPENDICES

APPENDIX A

TESTING PERFORMED FOR PHASE I

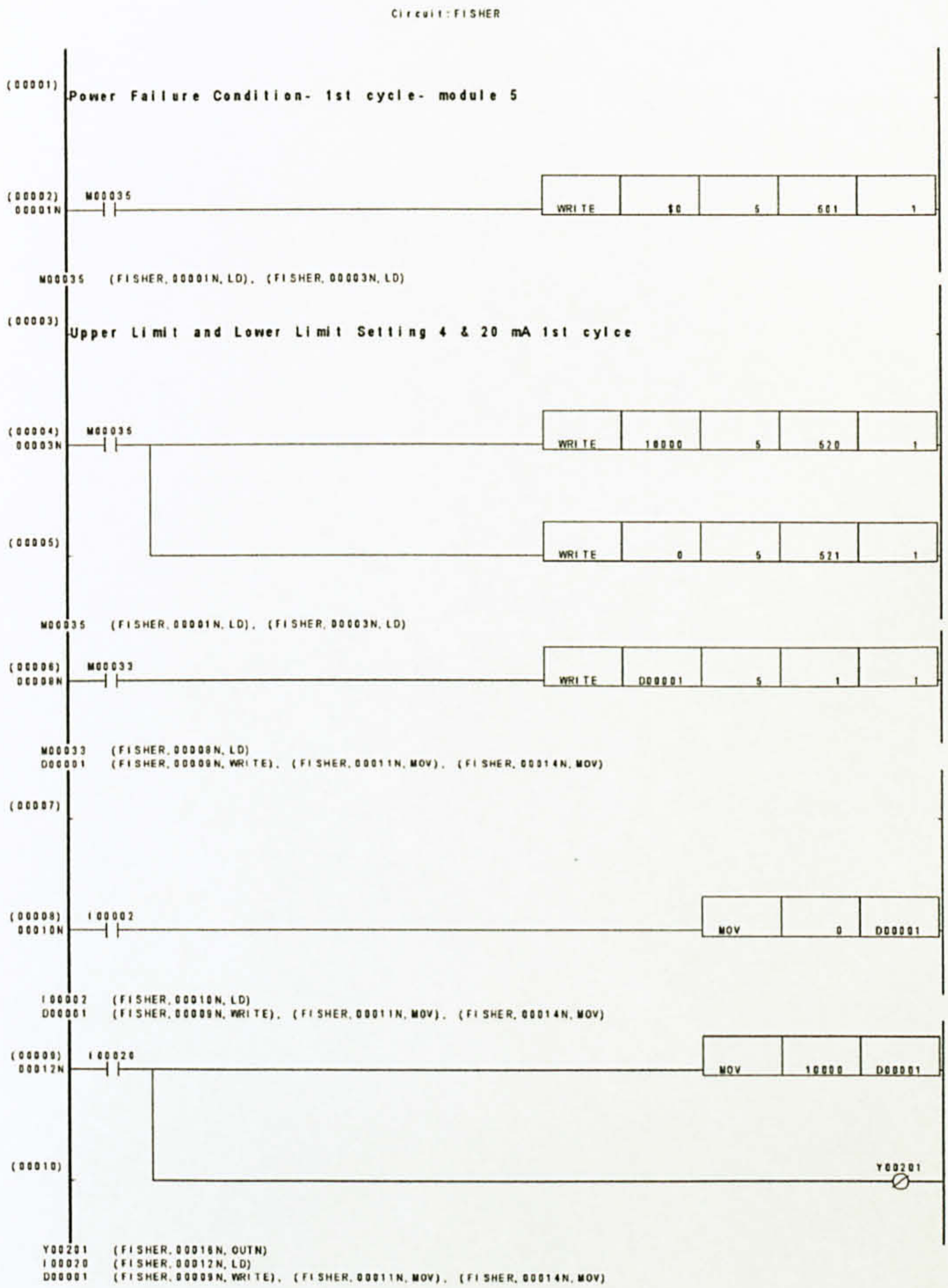
Day of testings	Date	
	Ball Valve	Butterfly Valve
1	31 Jan 2009	31 Jan 2009
2	1 Feb 2009	1 Feb 2009
3	2 Feb 2009	2 Feb 2009
4	4 Feb 2009	4 Feb 2009
5	5 Feb 2009	5 Feb 2009
6	8 Feb 2009	8 Feb 2009
7	10 Feb 2009	10 Feb 2009
8	11 Feb 2009	11 Feb 2009
9	12 Feb 2009	12 Feb 2009
10	13 Feb 2009	13 Feb 2009
11	14 Feb 2009	14 Feb 2009
12	16 Feb 2009	16 Feb 2009
13	17 Feb 2009	17 Feb 2009
14	18 Feb 2009	18 Feb 2009
15	19 Feb 2009	19 Feb 2009
16	21 Feb 2009	21 Feb 2009
17	22 Feb 2009	22 Feb 2009
18	23 Feb 2009	23 Feb 2009
19	24 Feb 2009	24 Feb 2009
20	26 Feb 2009	26 Feb 2009
21	1 Mar 2009	1 Mar 2009
22	3 Mar 2009	3 Mar 2009
23	4 Mar 2009	4 Mar 2009
24	7 Mar 2009	7 Mar 2009
25	8 Mar 2009	8 Mar 2009
26	10 Mar 2009	10 Mar 2009
27	16 Mar 2009	16 Mar 2009
28	18 Mar 2009	18 Mar 2009
29	19 Mar 2009	19 Mar 2009
30	28 Mar 2009	28 Mar 2009
31	29 Mar 2009	29 Mar 2009

32	1 Apr 2009	1 Apr 2009
33	9 Apr 2009	9 Apr 2009
34	10 Apr 2009	10 Apr 2009
35	9 June 2009	9 June 2009
36	14 Jul 2009	14 Jul 2009
37	15 Jul 2009	15 Jul 2009
38	16 Jul 2009	16 Jul 2009
39	18 Jul 2009	18 Jul 2009
40	19 Jul 2009	19 Jul 2009
41	21 Jul 2009	21 Jul 2009
42	22 Jul 2009	22 Jul 2009
43	23 Jul 2009	23 Jul 2009
44	24 Jul 2009	24 Jul 2009
45	25 Jul 2009	25 Jul 2009
46	26 Jul 2009	26 Jul 2009
47	27 Jul 2009	27 Jul 2009
48	28 Jul 2009	28 Jul 2009
49	29 Jul 2009	29 Jul 2009
50	30 Jul 2009	30 July 2009
51	10 Aug 2009	15 Aug 2009
52	11 Aug 2009	16 Aug 2009
53	12 Aug 2009	21 Aug 2009
54	13 Aug 2009	22 Aug 2009
55	14 Aug 2009	23 Aug 2009
56	15 Aug 2009	24 Aug 2009
57	16 Aug 2009	25 Aug 2009
58	21 Aug 2009	26 Aug 2009
59	22 Aug 2009	29 Aug 2009
60	23 Aug 2009	31 Aug 2009
61	24 Aug 2009	1 Sept 2009
62	25 Aug 2009	2 Sept 2009
63	26 Aug 2009	3 Sept 2009
64	29 Aug 2009	4 Sept 2009
65	31 Aug 2009	5 Sept 2009
66	1 Sept 2009	7 Sept 2009
67	2 Sept 2009	8 Sept 2009
68	3 Sept 2009	9 Sept 2009
69	4 Sept 2009	16 Sept 2009

70	5 Sept 2009	29 Sept 2009
71	7 Sept 2009	30 Sept 2009
72	8 Sept 2009	2 Oct 2009
73	9 Sept 2009	3 Oct 2009
74	10 Sept 2009	7 Oct 2009
75	14 Sept 2009	8 Oct 2009
76	15 Sept 2009	9 Oct 2009
77	16 Sept 2009	11 Oct 2009
78	29 Sept 2009	12 Oct 2009
79	30 Sept 2009	13 Oct 2009
80	3 Oct 2009	20 Oct 2009
81	8 Oct 2009	21 Oct 2009
82	11 Oct 2009	22 Oct 2009
83	12 Oct 2009	26 Oct 2009
84	13 Oct 2009	27 Oct 2009
85	20 Oct 2009	2 Nov 2009
86	21 Oct 2009	3 Nov 2009
87	22 Oct 2009	6 Nov 2009
88	26 Oct 2009	18 Jan 2010
89	27 Oct 2009	20 Jan 2010
90	2 Nov 2009	21 Jan 2010

APPENDIX B

LADDER LOGIC DIAGRAM FOR BALL VALVE

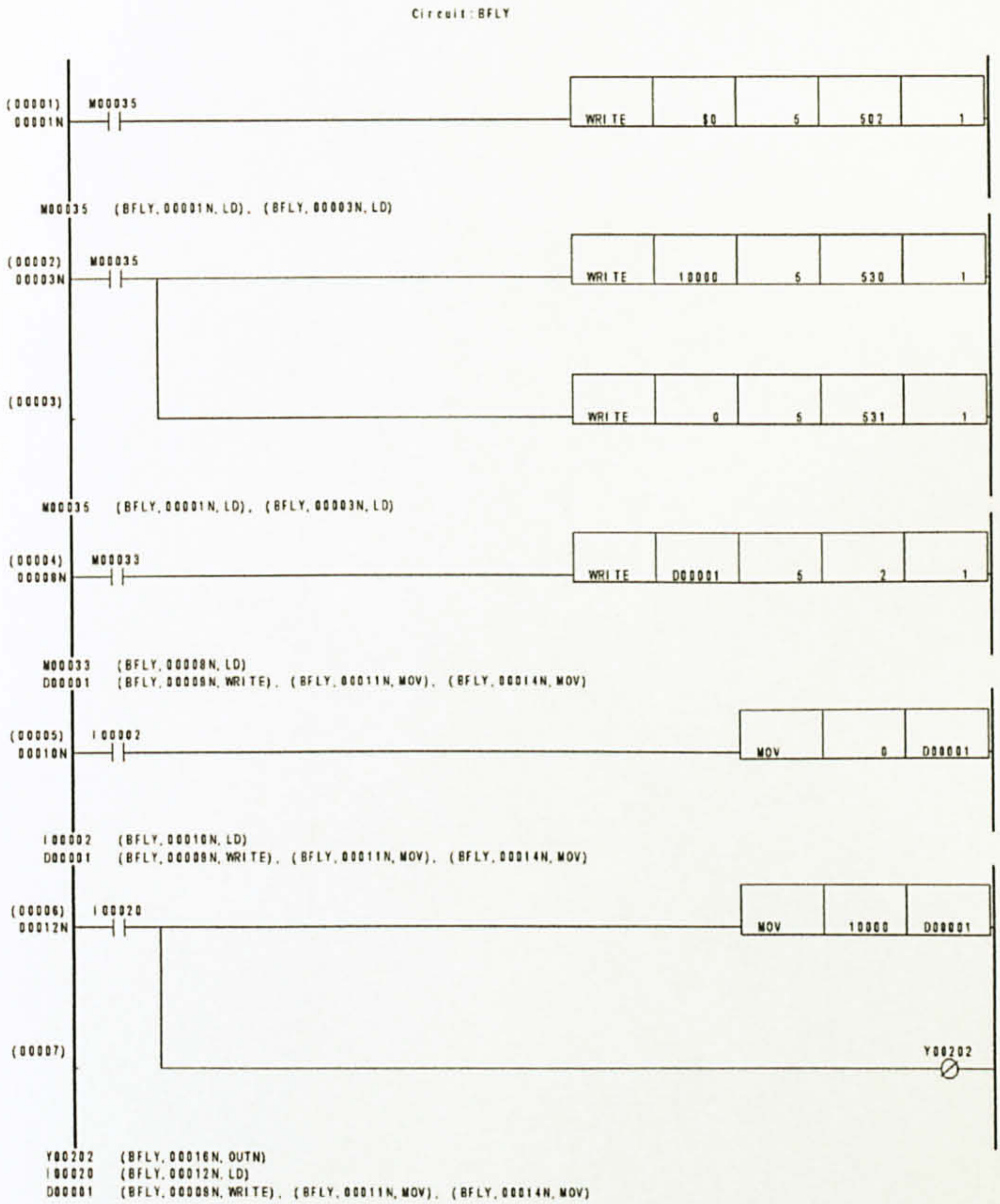


Device List:FISHER

Address	Tag Name	I/O Comment	Cross Reference
Y00201			(FISHER, 00016N, OUTN)
I00002			(FISHER, 00010N, LD)
I00020			(FISHER, 00012N, LD)
M00033			(FISHER, 00008N, LD)
M00035			(FISHER, 00001N, LD) (FISHER, 00003N, LD)
D00001			(FISHER, 00009N, WRITE) (FISHER, 00011N, MOV) (FISHER, 00014N, MOV)

APPENDIX C

LADDER LOGIC DIAGRAM FOR BUTTERFLY VALVE



Device List:BFLY

Address	Tag Name	I/O Comment	Cross Reference
Y00202			(BFLY, 00016N, OUTN)
I 00002			(BFLY, 00010N, LD)
I 00020			(BFLY, 00012N, LD)
M00033			(BFLY, 00008N, LD)
M00035			(BFLY, 00001N, LD) (BFLY, 00003N, LD)
D00001			(BFLY, 00009N, WRITE) (BFLY, 00011N, MOV) (BFLY, 00014N, MOV)

APPENDIX D

AMS VALVELINK GENERATED REPORT

BALL VALVE

DVC6000 SIS

HART Tag Name	PST
Valve Style	ROTARY
Actuator Style	Piston - Sgl w/ Spring
Instrument S/N	18477410
Valve S/N	18477410
Firmware Revision	7
Hardware Revision	1

Instrument Configuration [BALL VALVE] - Basic

10 Mar 2009 15:36:23

General	
HART Tag	PST
Message	
Descriptor	18477410
Date	02/18/08
Valve Serial Number	18477410
Instrument Serial Number	18477410
Polling Address	0
Initial Setup	
Control Mode	Digital
Restart Cont. Mode	Digital
Zero Power Condition	Valve Closed
Travel / Pressure Cutoff Lo (%)	50
Valve Style	Rotary Shaft
Actuator Style	Piston - Sgl w/ Spring
Relay Type	Relay A or C
Feedback Connection	Rotary-All/SS-Roller
Travel Sensor Motion	Counter-clockwise
Aux Terminal Mode	Push Button Partial Stroke Test
Partial Stroke Start Pt.	Valve Open
Inputs	
Analog Input Units	mA
Temperature Units	F
Input Characterization	
Input Characteristic	Linear

Pressure	
Max Supply Pressure	60 psi
Pressure Units	psi
Tuning	
Travel Control	
Travel Control Tuning Set	H
Proportional	8.4
Enable Integral Control	No
Integral Gain (reps/min)	9.4
Integral Settings	
Integral Dead Zone (%)	0.26
Integral Limit (%)	50
Pressure Control	
Pressure Control Tuning Set	H
Proportional	4.2
Enable Integral Control	Yes
Integral Gain (reps/sec)	0.1
SIS / Partial Stroke	
Partial Stroke	
Enable	Enabled
Test Start Point	
Partial Stroke Press Limit	18 psi
Max. Travel Movement (%)	20
Test Speed	0.5%/s
Test Pause Time	5 sec
Auto Test Interval (days)	0.00
SIS Options	
DVC Power Up	Auto Reset
Action on Failed test	Step Back

Travel/Pressure Control	
Travel/Pressure Control	
Travel / Pressure Select	Travel
Travel / Pressure Cutoff Lo (%)	50
Travel / Pressure Cutoff Hi (%)	50
End Point Press. Control	
End Point Control Enable	Enabled
Control End	
Pressure Set Point	51.8 psi
Pressure Saturation Time (sec)	45
Dynamic Response	
Set Point Rate Limits	
SP Rate Open (%/sec)	0
SP Rate Close (%/sec)	0
Set Point Filter	
Lag Time (sec)	0

ValveLink Custom Report

March 10, 2009
17:48:43

Instrument Configuration [BALL VALVE] - Alerts

10 Mar 2009 15:36:23

Self Test Shut Down	
Flash ROM Fail Enable	No
No Free Time Enable	No
Reference Voltage Fail Enable	No
NVM Fail Enable	No
Temp Sensor Fail Enable	No
Travel Sensor Fail Enable	No
Drive Current Fail Enable	No
Travel History Alerts	
Cycle Count Alert Enable	No
Cycle Count Deadband (%)	2.93
Cycle Count Alert Point	2147483646
Cycle Count	338
Trav Acc Alert Enable	No
Tvl Accum Deadband (%)	2.93
Tvl Accum Alert Pt (%)	2147483646
Travel Accumulator (%)	23243

Deviation & Other Alerts	
Travel Dev Alert Enable	Yes
Travel Dev Alert Pt (%)	5
Travel Dev Time (sec)	9.99
Pressure Dev Alert Enable	Yes
Pressure Dev Alert Pt	2 psi
Pressure Dev Time (sec)	9.99
Drive Signal Alert Enable	No
Supply Pressure Alert Point	0 psi
Supply Pressure Alert Enable	No
Travel Alerts	
Tvl Alert Lo Enable	No
Tvl Alert Hi Enable	No
Tvl Alert Lo Lo Enable	No
Tvl Alert Hi Hi Enable	No
Lo Point (%)	-25
Hi Point (%)	125
Lo Lo Point (%)	-25
Hi Hi Point (%)	125
Deadband (%)	1
Tvl Limit/Cutoff Lo Enable	No
Tvl Limit/Cutoff Hi Enable	No

Alert Record and Commands	
Instrument Clock	
Valve Alerts Enable	No
Failure Alerts Enable	Yes
Misc Alerts Enable	No
Burst Mode Enable	No
Burst Command	3
Cmd #3 (Trending) Pressure	A
Alert Record Not Empty Enable	No
Alert Record Full Enable	No
Informational Status	
Inst Time Invalid Enable	No
Cal in Progress Enable	No
Autocal in Progress Enable	No
Diag in Progress Enable	No
Diag Data Avail Enable	No
Integrator Sat Hi Enable	No
Integrator Sat Lo Enable	No
Press Ctrl Active Enable	No
Multi-Drop Alert Enable	No
Electronic Alerts	
Shutdown Activated Alert Enable	No
Power Starvation Alert Enable	No
Non-Critical NVM Alert Enable	No

Instrument Configuration [BALL VALVE] - Spec Sheet

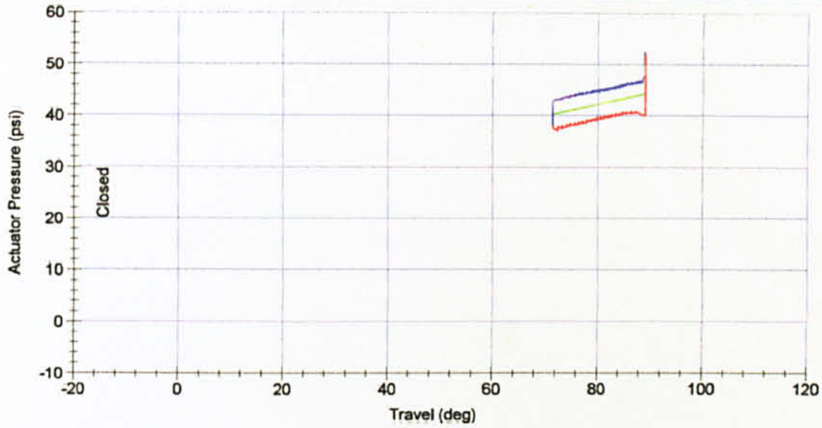
10 Mar 2009 15:36:23

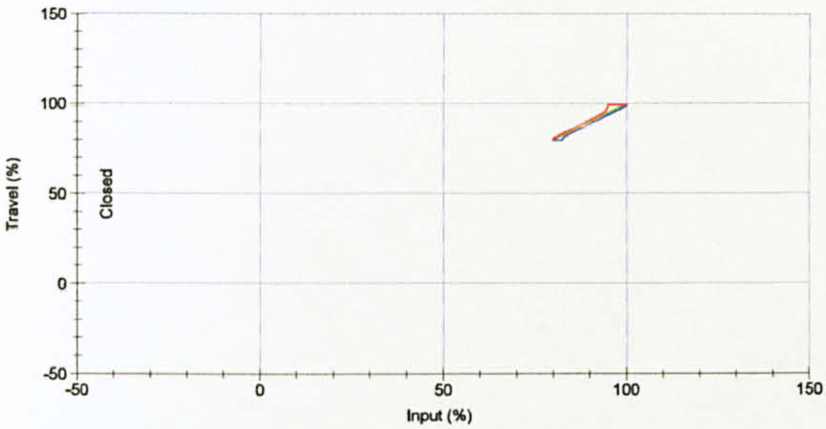
Spec Sheet Units	
Pressure Units	psi
Travel Units	deg
Length Units	in
Area Units	in2
Torque Units	lbf.in
Spring Rate Units	lbf/in
Valve	
Valve Mfg.	Fisher Controls
Valve Model	V-250
Size	6 in
Class	300
Rated Travel	90.0 deg
Actual Travel	90.0 deg
Stem Diameter	2.0 in
Packing Type	TFE / Single
Inlet Pressure	100.0 psi
Outlet Pressure	0.0 psi

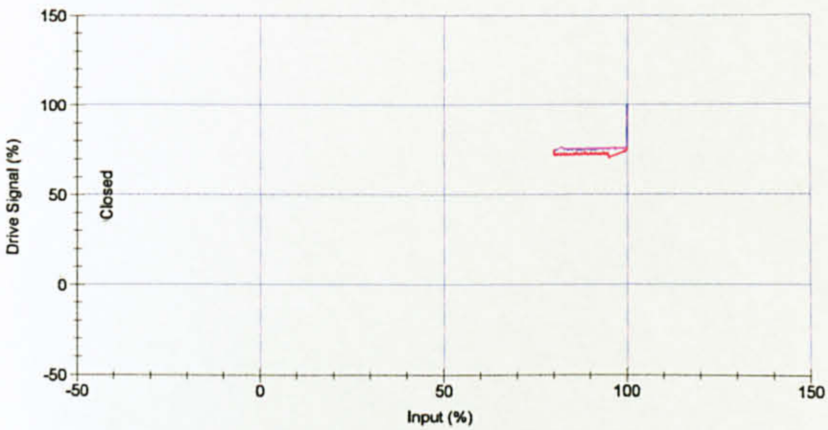
Trim	
Seat Type	Metal
Leak Class	V
Port Diameter	6.0 in
Actuator	
Actuator Mfg.	Fisher Controls
Actuator Model	1035
Actuator Size	40
Effective Area	0.0 in2
Air	Closes
Volume Booster/Quick Release	No
Lower Bench Set	0.0 psi
Upper Bench Set	0.0 psi
Nominal Supply Pressure	70.0 psi
Spring Rate	0.0 lbf/in
Lever Style	Rack and Pinion
Moment Arm	0.0 in

Reference	
Trim Style 1	
Trim Style 2	
Stroking Time Open (sec)	0
Stroking Time Closed (sec)	0
Dynamic Torque	0.0 lbf.in
Breakout Torque	0.0 lbf.in

Partial Stroke [BALL VALVE]







10 Mar 2009 15:37:57

Inputs

Input Start:	100.0 %
Input End:	80.0 %
Stroke Speed	0.5%/s
Test Pause Time:	5 sec
Collection Interval:	150.0 msec.

Analyzed Data

Avg. Dynamic Error:	2.16%
Min. Dynamic Error:	1.29%
Max. Dynamic Error:	2.91%
Dyn. Linearity (Ind.):	0.29%
Zero Ranged Travel at:	4.16 mA
Full Ranged Travel at:	20.05 mA
Average Torque:	NA
Minimum Torque:	NA
Maximum Torque:	NA
Spring Rate:	NA
Bench Set:	24.27 - 44.32 psi
Partial Stroke Test initiated by:	HART Command
Partial Stroke Test status:	Completed Successfully

Tuning Set

Tuning Set:	H
Gains	
Proportional:	8.40
Velocity:	4.20
MLF:	31.00
Integral Control:	Disabled
Integral Gain:	9.4

Notes

Valve

Manufacturer:	Fisher Controls
Type:	V-250
Size:	6 in
Class:	300
Rated Travel:	90.00 deg
Actual Travel:	90.00 deg
Shaft Diameter:	2.0000 in
Packing Type:	TFE / Single
Inlet Pressure:	100.0000 psi
Outlet Pressure:	0.0000 psi

Trim

Seat Type:	Metal
Leakage Class:	V
Port Diameter:	6.0000 in

Actuator

Manufacturer:	Fisher Controls
Type:	1035
Size:	40
Effective Area:	0.00 in2
Air:	Closes
Bench Set:	0.0000 psi- 0.0000 psi
Nominal Supply Pressure:	70.0000 psi
Spring Rate:	0.0000 lbf/in
Style:	Rack and Pinion
Moment Arm:	0.0000 in

Instrument Configuration [BALL VALVE] - Basic

10 Mar 2009 15:48:03

General	
HART Tag	PST
Message	
Descriptor	18477410
Date	02/18/08
Valve Serial Number	18477410
Instrument Serial Number	18477410
Polling Address	0
Initial Setup	
Control Mode	Digital
Restart Cont. Mode	Digital
Zero Power Condition	Valve Closed
Travel / Pressure Cutoff Lo (%)	50
Valve Style	Rotary Shaft
Actuator Style	Piston - Sgl w/ Spring
Relay Type	Relay A or C
Feedback Connection	Rotary-All/SS-Roller
Travel Sensor Motion	Counter-clockwise
Aux Terminal Mode	Push Button Partial Stroke Test
Partial Stroke Start Pt.	Valve Open
Inputs	
Analog Input Units	mA
Temperature Units	F
Input Characterization	
Input Characteristic	Linear

Pressure	
Max Supply Pressure	60 psi
Pressure Units	psi
Tuning	
Travel Control	
Travel Control Tuning Set	H
Proportional	8.4
Enable Integral Control	No
Integral Gain (reps/min)	9.4
Integral Settings	
Integral Dead Zone (%)	0.26
Integral Limit (%)	50
Pressure Control	
Pressure Control Tuning Set	H
Proportional	4.2
Enable Integral Control	Yes
Integral Gain (reps/sec)	0.1
SIS / Partial Stroke	
Partial Stroke	
Enable	Enabled
Test Start Point	
Partial Stroke Press Limit	18 psi
Max. Travel Movement (%)	20
Test Speed	0.5%/s
Test Pause Time	5 sec
Auto Test Interval (days)	0.00
SIS Options	
DVC Power Up	Auto Reset
Action on Failed test	Step Back

Travel/Pressure Control	
Travel/Pressure Control	
Travel / Pressure Select	Travel
Travel / Pressure Cutoff Lo (%)	50
Travel / Pressure Cutoff Hi (%)	50
End Point Press. Control	
End Point Control Enable	Enabled
Control End	
Pressure Set Point	51.8 psi
Pressure Saturation Time (sec)	45
Dynamic Response	
Set Point Rate Limits	
SP Rate Open (%/sec)	0
SP Rate Close (%/sec)	0
Set Point Filter	
Lag Time (sec)	0

Instrument Configuration [BALL VALVE] - Alerts

10 Mar 2009 15:48:03

Self Test Shut Down	
Flash ROM Fail Enable	No
No Free Time Enable	No
Reference Voltage Fail Enable	No
NVM Fail Enable	No
Temp Sensor Fail Enable	No
Travel Sensor Fail Enable	No
Drive Current Fail Enable	No
Travel History Alerts	
Cycle Count Alert Enable	No
Cycle Count Deadband (%)	2.93
Cycle Count Alert Point	2147483646
Cycle Count	339
Trav Acc Alert Enable	No
Tvl Accum Deadband (%)	2.93
Tvl Accum Alert Pt (%)	2147483646
Travel Accumulator (%)	23280

Deviation & Other Alerts	
Travel Dev Alert Enable	Yes
Travel Dev Alert Pt (%)	5
Travel Dev Time (sec)	9.99
Pressure Dev Alert Enable	Yes
Pressure Dev Alert Pt	2 psi
Pressure Dev Time (sec)	9.99
Drive Signal Alert Enable	No
Supply Pressure Alert Point	0 psi
Supply Pressure Alert Enable	No
Travel Alerts	
Tvl Alert Lo Enable	No
Tvl Alert Hi Enable	No
Tvl Alert Lo Lo Enable	No
Tvl Alert Hi Hi Enable	No
Lo Point (%)	-25
Hi Point (%)	125
Lo Lo Point (%)	-25
Hi Hi Point (%)	125
Deadband (%)	1
Tvl Limit/Cutoff Lo Enable	No
Tvl Limit/Cutoff Hi Enable	No

Alert Record and Commands	
Instrument Clock	
Valve Alerts Enable	No
Failure Alerts Enable	Yes
Misc Alerts Enable	No
Burst Mode Enable	No
Burst Command	3
Cmd #3 (Trending) Pressure	A
Alert Record Not Empty Enable	No
Alert Record Full Enable	No
Informational Status	
Inst Time Invalid Enable	No
Cal in Progress Enable	No
Autocal in Progress Enable	No
Diag in Progress Enable	No
Diag Data Avail Enable	No
Integrator Sat Hi Enable	No
Integrator Sat Lo Enable	No
Press Ctrl Active Enable	No
Multi-Drop Alert Enable	No
Electronic Alerts	
Shutdown Activated Alert Enable	No
Power Starvation Alert Enable	No
Non-Critical NVM Alert Enable	No

Instrument Configuration [BALL VALVE] - Spec Sheet

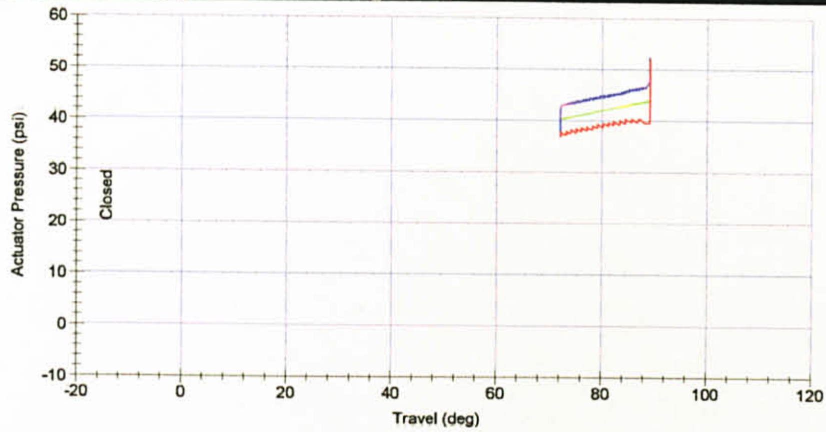
10 Mar 2009 15:48:03

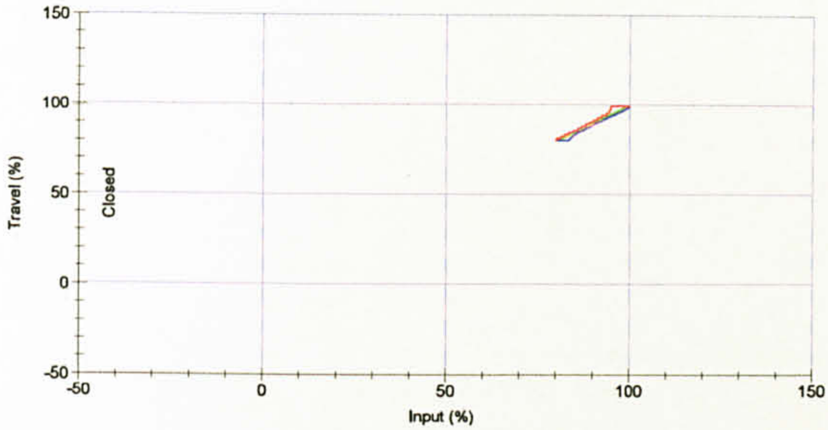
Spec Sheet Units	
Pressure Units	psi
Travel Units	deg
Length Units	in
Area Units	in2
Torque Units	lbf.in
Spring Rate Units	lbf/in
Valve	
Valve Mfg.	Fisher Controls
Valve Model	V-250
Size	6 in
Class	300
Rated Travel	90.0 deg
Actual Travel	90.0 deg
Stem Diameter	2.0 in
Packing Type	TFE / Single
Inlet Pressure	100.0 psi
Outlet Pressure	0.0 psi

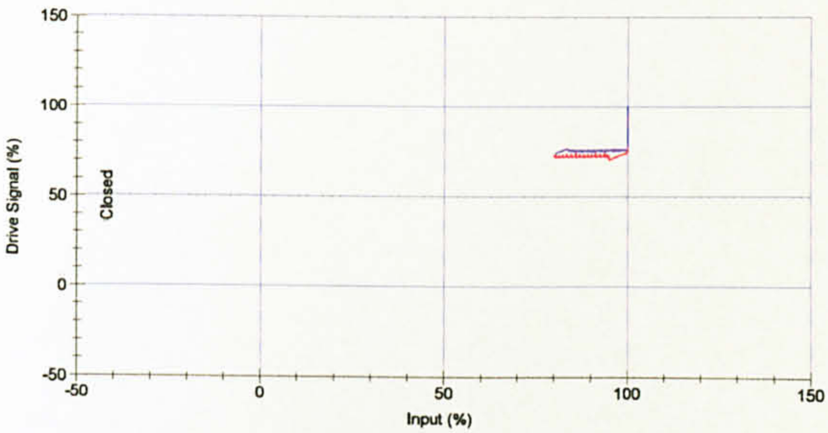
Trim	
Seat Type	Metal
Leak Class	V
Port Diameter	6.0 in
Actuator	
Actuator Mfg.	Fisher Controls
Actuator Model	1035
Actuator Size	40
Effective Area	0.0 in2
Air	Closes
Volume Booster/Quick Release	No
Lower Bench Set	0.0 psi
Upper Bench Set	0.0 psi
Nominal Supply Pressure	70.0 psi
Spring Rate	0.0 lbf/in
Lever Style	Rack and Pinion
Moment Arm	0.0 in

Reference	
Trim Style 1	
Trim Style 2	
Stroking Time Open (sec)	0
Stroking Time Closed (sec)	0
Dynamic Torque	0.0 lbf.in
Breakout Torque	0.0 lbf.in

Partial Stroke [BALL VALVE]







10 Mar 2009 15:50:44

Inputs

Input Start:	100.0 %
Input End:	80.0 %
Stroke Speed	0.5%/s
Test Pause Time:	5 sec
Collection Interval:	150.0 msec.

Analyzed Data

Avg. Dynamic Error:	2.18%
Min. Dynamic Error:	1.18%
Max. Dynamic Error:	2.97%
Dyn. Linearity (Ind.):	0.52%
Zero Ranged Travel at:	4.23 mA
Full Ranged Travel at:	20.05 mA
Average Torque:	NA
Minimum Torque:	NA
Maximum Torque:	NA
Spring Rate:	NA
Bench Set:	25.05 - 44.01 psi
Partial Stroke Test initiated by:	HART Command
Partial Stroke Test status:	Completed Successfully

Tuning Set

Tuning Set:	H
Gains	
Proportional:	8.40
Velocity:	4.20
MLF:	31.00
Integral Control:	Disabled
Integral Gain:	9.4

Notes

Valve

Manufacturer:	Fisher Controls
Type:	V-250
Size:	6 in
Class:	300
Rated Travel:	90.00 deg
Actual Travel:	90.00 deg
Shaft Diameter:	2.0000 in
Packing Type:	TFE / Single
Inlet Pressure:	100.0000 psi
Outlet Pressure:	0.0000 psi

Trim

Seat Type:	Metal
Leakage Class:	V
Port Diameter:	6.0000 in

Actuator

Manufacturer:	Fisher Controls
Type:	1035
Size:	40
Effective Area:	0.00 in2
Air:	Closes
Bench Set:	0.0000 psi-0.0000 psi
Nominal Supply Pressure:	70.0000 psi
Spring Rate:	0.0000 lbf/in
Style:	Rack and Pinion
Moment Arm:	0.0000 in

strument Configuration [BALL VALVE] - Basic

10 Mar 2009 16:01:53

General	
HART Tag	PST
Message	
Descriptor	18477410
Date	02/18/08
Valve Serial Number	18477410
nstrument Serial Number	18477410
Polling Address	0
Initial Setup	
Control Mode	Digital
Restart Cont. Mode	Digital
Zero Power Condition	Valve Closed
avel / Pressure Cutoff Lo (%)	50
Valve Style	Rotary Shaft
Actuator Style	Piston - Sgl w/ Spring
Relay Type	Relay A or C
Feedback Connection	Rotary-All/SS-Roller
Travel Sensor Motion	Counter-clockwise
Aux Terminal Mode	Push Button Partial Stroke Test
Partial Stroke Start Pt.	Valve Open
Inputs	
Analog Input Units	mA
Temperature Units	F
Input Characterization	
Input Characteristic	Linear

Pressure	
Max Supply Pressure	60 psi
Pressure Units	psi
Tuning	
Travel Control	
Travel Control Tuning Set	H
Proportional	8.4
Enable Integral Control	No
Integral Gain (reps/min)	9.4
Integral Settings	
Integral Dead Zone (%)	0.26
Integral Limit (%)	50
Pressure Control	
Pressure Control Tuning Set	H
Proportional	4.2
Enable Integral Control	Yes
Integral Gain (reps/sec)	0.1
SIS / Partial Stroke	
Partial Stroke	
Enable	Enabled
Test Start Point	
Partial Stroke Press Limit	18 psi
Max. Travel Movement (%)	20
Test Speed	0.5%/s
Test Pause Time	5 sec
Auto Test Interval (days)	0.00
SIS Options	
DVC Power Up	Auto Reset
Action on Failed test	Step Back

Travel/Pressure Control	
Travel/Pressure Control	
Travel / Pressure Select	Travel
Travel / Pressure Cutoff Lo (%)	50
Travel / Pressure Cutoff Hi (%)	50
End Point Press. Control	
End Point Control Enable	Enabled
Control End	
Pressure Set Point	51.8 psi
Pressure Saturation Time (sec)	45
Dynamic Response	
Set Point Rate Limits	
SP Rate Open (%/sec)	0
SP Rate Close (%/sec)	0
Set Point Filter	
Lag Time (sec)	0

Instrument Configuration [BALL VALVE] - Alerts

10 Mar 2009 16:01:53

Self Test Shut Down

Flash ROM Fail Enable	No
No Free Time Enable	No
Reference Voltage Fail Enable	No
NVM Fail Enable	No
Temp Sensor Fail Enable	No
Travel Sensor Fail Enable	No
Drive Current Fail Enable	No

Travel History Alerts

Cycle Count Alert Enable	No
Cycle Count Deadband (%)	2.93
Cycle Count Alert Point	2147483646
Cycle Count	341
Trav Acc Alert Enable	No
Tvl Accum Deadband (%)	2.93
Tvl Accum Alert Pt (%)	2147483646
Travel Accumulator (%)	23319

Deviation & Other Alerts

Travel Dev Alert Enable	Yes
Travel Dev Alert Pt (%)	5
Travel Dev Time (sec)	9.99
Pressure Dev Alert Enable	Yes
Pressure Dev Alert Pt	2 psi
Pressure Dev Time (sec)	9.99
Drive Signal Alert Enable	No
Supply Pressure Alert Point	0 psi
Supply Pressure Alert Enable	No

Travel Alerts

Tvl Alert Lo Enable	No
Tvl Alert Hi Enable	No
Tvl Alert Lo Lo Enable	No
Tvl Alert Hi Hi Enable	No
Lo Point (%)	-25
Hi Point (%)	125
Lo Lo Point (%)	-25
Hi Hi Point (%)	125
Deadband (%)	1
Tvl Limit/Cutoff Lo Enable	No
Tvl Limit/Cutoff Hi Enable	No

Alert Record and Commands

Instrument Clock	10 JAN 2009 03:56
Valve Alerts Enable	No
Failure Alerts Enable	Yes
Misc Alerts Enable	No
Burst Mode Enable	No
Burst Command	3
Cmd #3 (Trending) Pressure	A
Alert Record Not Empty Enable	No
Alert Record Full Enable	No

Informational Status

Inst Time Invalid Enable	No
Cal in Progress Enable	No
Autocal in Progress Enable	No
Diag in Progress Enable	No
Diag Data Avail Enable	No
Integrator Sat Hi Enable	No
Integrator Sat Lo Enable	No
Press Ctrl Active Enable	No
Multi-Drop Alert Enable	No

Electronic Alerts

Shutdown Activated Alert Enable	No
Power Starvation Alert Enable	No
Non-Critical NVM Alert Enable	No

Instrument Configuration [BALL VALVE] - Spec Sheet

10 Mar 2009 16:01:53

Spec Sheet Units

Pressure Units	psi
Travel Units	deg
Length Units	in
Area Units	in2
Torque Units	lbf.in
Spring Rate Units	lbf/in

Valve

Valve Mfg.	Fisher Controls
Valve Model	V-250
Size	6 in
Class	300
Rated Travel	90.0 deg
Actual Travel	90.0 deg
Stem Diameter	2.0 in
Packing Type	TFE / Single
Inlet Pressure	100.0 psi
Outlet Pressure	0.0 psi

Trim

Seat Type	Metal
Leak Class	V
Port Diameter	6.0 in

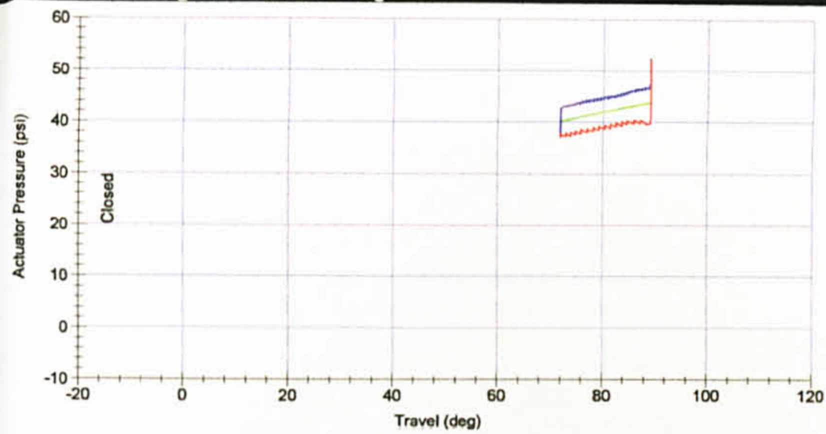
Actuator

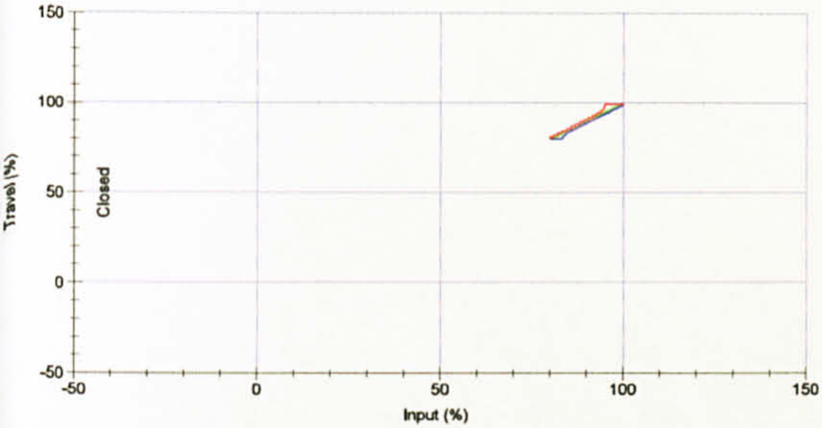
Actuator Mfg.	Fisher Controls
Actuator Model	1035
Actuator Size	40
Effective Area	0.0 in2
Air	Closes
Volume Booster/Quick Release	No
Lower Bench Set	0.0 psi
Upper Bench Set	0.0 psi
Nominal Supply Pressure	70.0 psi
Spring Rate	0.0 lbf/in
Lever Style	Rack and Pinion
Moment Arm	0.0 in

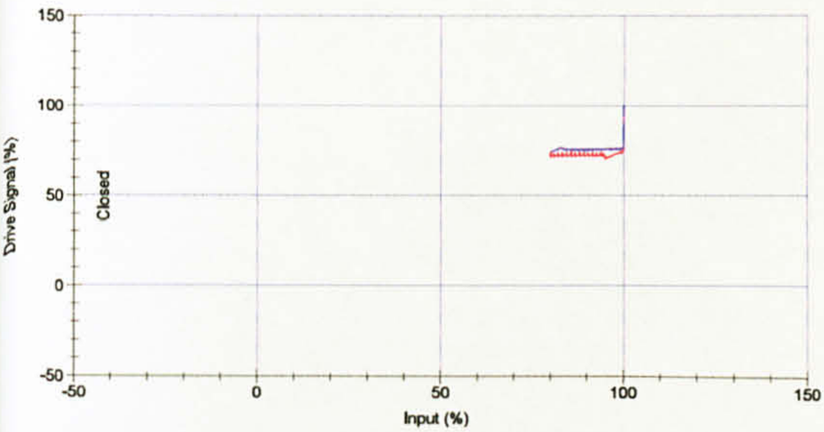
Reference

Trim Style 1	
Trim Style 2	
Stroking Time Open (sec)	0
Stroking Time Closed (sec)	0
Dynamic Torque	0.0 lbf.in
Breakout Torque	0.0 lbf.in

tial Stroke [BALL VALVE]







10 Mar 2009 16:02:25

Inputs

Input Start:	100.0 %
Input End:	80.0 %
Stroke Speed	0.5%/s
Test Pause Time:	5 sec
Collection Interval:	150.0 msec.

Analyzed Data

Avg. Dynamic Error:	2.12%
Min. Dynamic Error:	1.18%
Max. Dynamic Error:	2.96%
Dyn. Linearity (Ind.):	0.48%
Zero Ranged Travel at:	4.19 mA
Full Ranged Travel at:	20.04 mA
Average Torque:	NA
Minimum Torque:	NA
Maximum Torque:	NA
Spring Rate:	NA
Bench Set:	24.9 - 43.95 psi
Partial Stroke Test initiated by:	HART Command
Partial Stroke Test status:	Completed Successfully

Tuning Set

Tuning Set:	H
Gains	
Proportional:	8.40
Velocity:	4.20
MLF:	31.00
Integral Control:	Disabled
Integral Gain:	9.4

Notes

Valve

Manufacturer:	Fisher Controls
Type:	V-250
Size:	6 in
Class:	300
Rated Travel:	90.00 deg
Actual Travel:	90.00 deg
Shaft Diameter:	2.0000 in
Packing Type:	TFE / Single
Inlet Pressure:	100.0000 psi
Outlet Pressure:	0.0000 psi

Trim

Seat Type:	Metal
Leakage Class:	V
Port Diameter:	6.0000 in

Actuator

Manufacturer:	Fisher Controls
Type:	1035
Size:	40
Effective Area:	0.00 in2
Air:	Closes
Bench Set:	0.0000 psi-0.0000 psi
Nominal Supply Pressure:	70.0000 psi
Spring Rate:	0.0000 lbf/in
Style:	Rack and Pinion
Moment Arm:	0.0000 in

Instrument Configuration [BALL VALVE] - Basic

10 Mar 2009 16:09:48

General	
HART Tag	PST
Message	
Descriptor	18477410
Date	02/18/08
Valve Serial Number	18477410
Instrument Serial Number	18477410
Polling Address	0
Initial Setup	
Control Mode	Digital
Restart Cont. Mode	Digital
Zero Power Condition	Valve Closed
Travel / Pressure Cutoff Lo (%)	50
Valve Style	Rotary Shaft
Actuator Style	Piston - Sgl w/ Spring
Relay Type	Relay A or C
Feedback Connection	Rotary-All/SS-Roller
Travel Sensor Motion	Counter-clockwise
Aux Terminal Mode	Push Button Partial Stroke Test
Partial Stroke Start Pt.	Valve Open
Inputs	
Analog Input Units	mA
Temperature Units	F
Input Characterization	
Input Characteristic	Linear

Pressure	
Max Supply Pressure	60 psi
Pressure Units	psi
Tuning	
Travel Control	
Travel Control Tuning Set	H
Proportional	8.4
Enable Integral Control	No
Integral Gain (reps/min)	9.4
Integral Settings	
Integral Dead Zone (%)	0.26
Integral Limit (%)	50
Pressure Control	
Pressure Control Tuning Set	H
Proportional	4.2
Enable Integral Control	Yes
Integral Gain (reps/sec)	0.1
SIS / Partial Stroke	
Partial Stroke	
Enable	Enabled
Test Start Point	
Partial Stroke Press Limit	18 psi
Max. Travel Movement (%)	20
Test Speed	0.5%/s
Test Pause Time	5 sec
Auto Test Interval (days)	0.00
SIS Options	
DVC Power Up	Auto Reset
Action on Failed test	Step Back

Travel/Pressure Control	
Travel/Pressure Control	
Travel / Pressure Select	Travel
Travel / Pressure Cutoff Lo (%)	50
Travel / Pressure Cutoff Hi (%)	50
End Point Press. Control	
End Point Control Enable	Enabled
Control End	
Pressure Set Point	51.8 psi
Pressure Saturation Time (sec)	45
Dynamic Response	
Set Point Rate Limits	
SP Rate Open (%/sec)	0
SP Rate Close (%/sec)	0
Set Point Filter	
Lag Time (sec)	0

Instrument Configuration [BALL VALVE] - Alerts

10 Mar 2009 16:09:48

Self Test Shut Down	
Flash ROM Fail Enable	No
No Free Time Enable	No
Reference Voltage Fail Enable	No
NVM Fail Enable	No
Temp Sensor Fail Enable	No
Travel Sensor Fail Enable	No
Drive Current Fail Enable	No
Travel History Alerts	
Cycle Count Alert Enable	No
Cycle Count Deadband (%)	2.93
Cycle Count Alert Point	2147483646
Cycle Count	343
Trav Acc Alert Enable	No
Tvl Accum Deadband (%)	2.93
Tvl Accum Alert Pt (%)	2147483646
Travel Accumulator (%)	23359

Deviation & Other Alerts	
Travel Dev Alert Enable	Yes
Travel Dev Alert Pt (%)	5
Travel Dev Time (sec)	9.99
Pressure Dev Alert Enable	Yes
Pressure Dev Alert Pt	2 psi
Pressure Dev Time (sec)	9.99
Drive Signal Alert Enable	No
Supply Pressure Alert Point	0 psi
Supply Pressure Alert Enable	No
Travel Alerts	
Tvl Alert Lo Enable	No
Tvl Alert Hi Enable	No
Tvl Alert Lo Lo Enable	No
Tvl Alert Hi Hi Enable	No
Lo Point (%)	-25
Hi Point (%)	125
Lo Lo Point (%)	-25
Hi Hi Point (%)	125
Deadband (%)	1
Tvl Limit/Cutoff Lo Enable	No
Tvl Limit/Cutoff Hi Enable	No

Alert Record and Commands	
Instrument Clock	10 JAN 2009 04:02
Valve Alerts Enable	No
Failure Alerts Enable	Yes
Misc Alerts Enable	No
Burst Mode Enable	No
Burst Command	3
Cmd #3 (Trending) Pressure	A
Alert Record Not Empty Enable	No
Alert Record Full Enable	No
Informational Status	
Inst Time Invalid Enable	No
Cal in Progress Enable	No
Autocal in Progress Enable	No
Diag in Progress Enable	No
Diag Data Avail Enable	No
Integrator Sat Hi Enable	No
Integrator Sat Lo Enable	No
Press Ctrl Active Enable	No
Multi-Drop Alert Enable	No
Electronic Alerts	
Shutdown Activated Alert Enable	No
Power Starvation Alert Enable	No
Non-Critical NVM Alert Enable	No

Instrument Configuration [BALL VALVE] - Spec Sheet

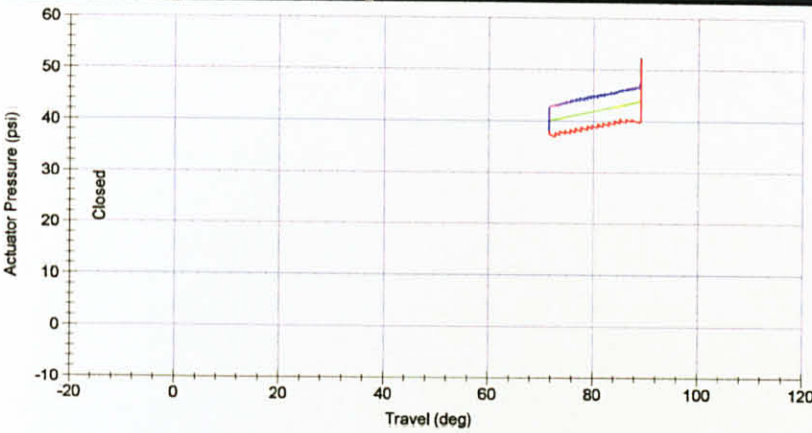
10 Mar 2009 16:09:48

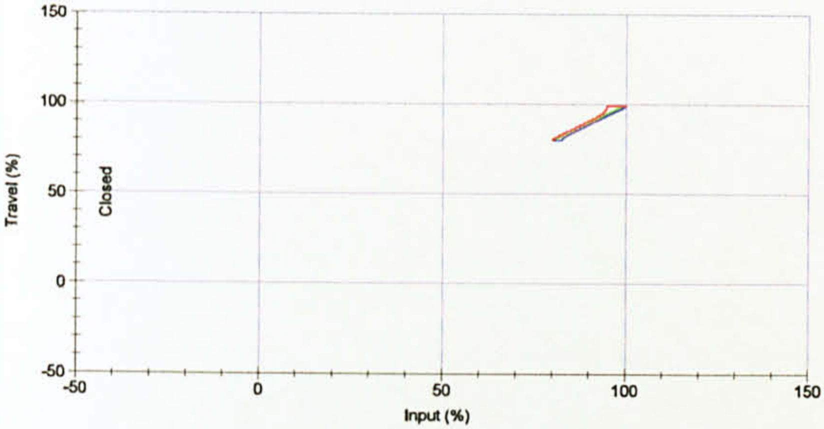
Spec Sheet Units	
Pressure Units	psi
Travel Units	deg
Length Units	in
Area Units	in2
Torque Units	lbf.in
Spring Rate Units	lbf/in
Valve	
Valve Mfg.	Fisher Controls
Valve Model	V-250
Size	6 in
Class	300
Rated Travel	90.0 deg
Actual Travel	90.0 deg
Stem Diameter	2.0 in
Packing Type	TFE / Single
Inlet Pressure	100.0 psi
Outlet Pressure	0.0 psi

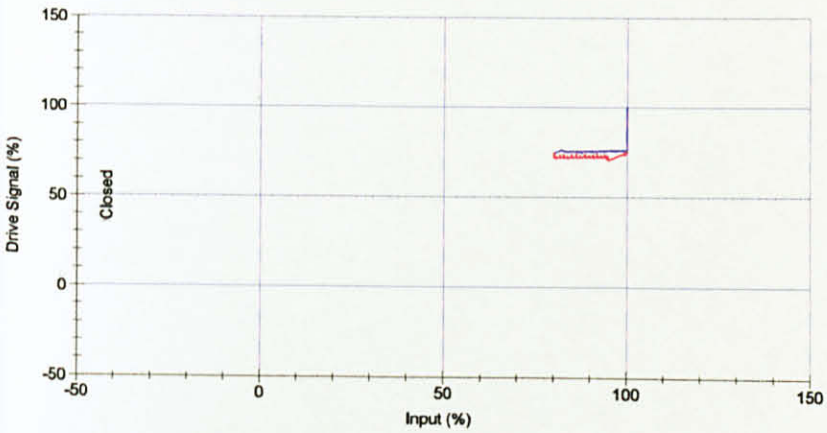
Trim	
Seat Type	Metal
Leak Class	V
Port Diameter	6.0 in
Actuator	
Actuator Mfg.	Fisher Controls
Actuator Model	1035
Actuator Size	40
Effective Area	0.0 in2
Air	Closes
Volume Booster/Quick Release	No
Lower Bench Set	0.0 psi
Upper Bench Set	0.0 psi
Nominal Supply Pressure	70.0 psi
Spring Rate	0.0 lbf/in
Lever Style	Rack and Pinion
Moment Arm	0.0 in

Reference	
Trim Style 1	
Trim Style 2	
Stroking Time Open (sec)	0
Stroking Time Closed (sec)	0
Dynamic Torque	0.0 lbf.in
Breakout Torque	0.0 lbf.in

Partial Stroke [BALL VALVE]







10 Mar 2009 16:10:04

Inputs

Input Start:	100.0 %
Input End:	80.0 %
Stroke Speed	0.5%/s
Test Pause Time:	5 sec
Collection Interval:	150.0 msec.

Analyzed Data

Avg. Dynamic Error:	2.15%
Min. Dynamic Error:	1.55%
Max. Dynamic Error:	2.91%
Dyn. Linearity (Ind.):	0.49%
Zero Ranged Travel at:	4.17 mA
Full Ranged Travel at:	20.04 mA
Average Torque:	NA
Minimum Torque:	NA
Maximum Torque:	NA
Spring Rate:	NA
Bench Set:	24.77 - 43.97 psi
Partial Stroke Test initiated by:	HART Command
Partial Stroke Test status:	Completed Successfully

Tuning Set

Tuning Set:	H
Gains	
Proportional:	8.40
Velocity:	4.20
MLF:	31.00
Integral Control:	Disabled
Integral Gain:	9.4

Notes

Valve

Manufacturer:	Fisher Controls
Type:	V-250
Size:	6 in
Class:	300
Rated Travel:	90.00 deg
Actual Travel:	90.00 deg
Shaft Diameter:	2.0000 in
Packing Type:	TFE / Single
Inlet Pressure:	100.0000 psi
Outlet Pressure:	0.0000 psi

Trim

Seat Type:	Metal
Leakage Class:	V
Port Diameter:	6.0000 in

Actuator

Manufacturer:	Fisher Controls
Type:	1035
Size:	40
Effective Area:	0.00 in2
Air:	Closes
Bench Set:	0.0000 psi-0.0000 psi
Nominal Supply Pressure:	70.0000 psi
Spring Rate:	0.0000 lbf/in
Style:	Rack and Pinion
Moment Arm:	0.0000 in

Instrument Configuration [BALL VALVE] - Basic

10 Mar 2009 16:19:50

General	
HART Tag	PST
Message	
Descriptor	18477410
Date	02/18/08
Valve Serial Number	18477410
Instrument Serial Number	18477410
Polling Address	0
Initial Setup	
Control Mode	Digital
Restart Cont. Mode	Digital
Zero Power Condition	Valve Closed
Travel / Pressure Cutoff Lo (%)	50
Valve Style	Rotary Shaft
Actuator Style	Piston - Sgl w/ Spring
Relay Type	Relay A or C
Feedback Connection	Rotary-All/SS-Roller
Travel Sensor Motion	Counter-clockwise
Aux Terminal Mode	Push Button Partial Stroke Test
Partial Stroke Start Pt.	Valve Open
Inputs	
Analog Input Units	mA
Temperature Units	F
Input Characterization	
Input Characteristic	Linear

Pressure	
Max Supply Pressure	60 psi
Pressure Units	psi
Tuning	
Travel Control	
Travel Control Tuning Set	H
Proportional	8.4
Enable Integral Control	No
Integral Gain (reps/min)	9.4
Integral Settings	
Integral Dead Zone (%)	0.26
Integral Limit (%)	50
Pressure Control	
Pressure Control Tuning Set	H
Proportional	4.2
Enable Integral Control	Yes
Integral Gain (reps/sec)	0.1
SIS / Partial Stroke	
Partial Stroke	
Enable	Enabled
Test Start Point	
Partial Stroke Press Limit	18 psi
Max. Travel Movement (%)	20
Test Speed	0.5%/s
Test Pause Time	5 sec
Auto Test Interval (days)	0.00
SIS Options	
DVC Power Up	Auto Reset
Action on Failed test	Step Back

Travel/Pressure Control	
Travel/Pressure Control	
Travel / Pressure Select	Travel
Travel / Pressure Cutoff Lo (%)	50
Travel / Pressure Cutoff Hi (%)	50
End Point Press. Control	
End Point Control Enable	Enabled
Control End	
Pressure Set Point	51.8 psi
Pressure Saturation Time (sec)	45
Dynamic Response	
Set Point Rate Limits	
SP Rate Open (%/sec)	0
SP Rate Close (%/sec)	0
Set Point Filter	
Lag Time (sec)	0

Instrument Configuration [BALL VALVE] - Alerts

10 Mar 2009 16:19:50

Self Test Shut Down	
Flash ROM Fail Enable	No
No Free Time Enable	No
Reference Voltage Fail Enable	No
NVM Fail Enable	No
Temp Sensor Fail Enable	No
Travel Sensor Fail Enable	No
Drive Current Fail Enable	No
Travel History Alerts	
Cycle Count Alert Enable	No
Cycle Count Deadband (%)	2.93
Cycle Count Alert Point	2147483646
Cycle Count	345
Trav Acc Alert Enable	No
Tvl Accum Deadband (%)	2.93
Tvl Accum Alert Pt (%)	2147483646
Travel Accumulator (%)	23399

Deviation & Other Alerts	
Travel Dev Alert Enable	Yes
Travel Dev Alert Pt (%)	5
Travel Dev Time (sec)	9.99
Pressure Dev Alert Enable	Yes
Pressure Dev Alert Pt	2 psi
Pressure Dev Time (sec)	9.99
Drive Signal Alert Enable	No
Supply Pressure Alert Point	0 psi
Supply Pressure Alert Enable	No
Travel Alerts	
Tvl Alert Lo Enable	No
Tvl Alert Hi Enable	No
Tvl Alert Lo Lo Enable	No
Tvl Alert Hi Hi Enable	No
Lo Point (%)	-25
Hi Point (%)	125
Lo Lo Point (%)	-25
Hi Hi Point (%)	125
Deadband (%)	1
Tvl Limit/Cutoff Lo Enable	No
Tvl Limit/Cutoff Hi Enable	No

Alert Record and Commands	
Instrument Clock	10 JAN 2009 04:12
Valve Alerts Enable	No
Failure Alerts Enable	Yes
Misc Alerts Enable	No
Burst Mode Enable	No
Burst Command	3
Cmd #3 (Trending) Pressure	A
Alert Record Not Empty Enable	No
Alert Record Full Enable	No
Informational Status	
Inst Time Invalid Enable	No
Cal in Progress Enable	No
Autocal in Progress Enable	No
Diag in Progress Enable	No
Diag Data Avail Enable	No
Integrator Sat Hi Enable	No
Integrator Sat Lo Enable	No
Press Ctrl Active Enable	No
Multi-Drop Alert Enable	No
Electronic Alerts	
Shutdown Activated Alert Enable	No
Power Starvation Alert Enable	No
Non-Critical NVM Alert Enable	No

Instrument Configuration [BALL VALVE] - Spec Sheet

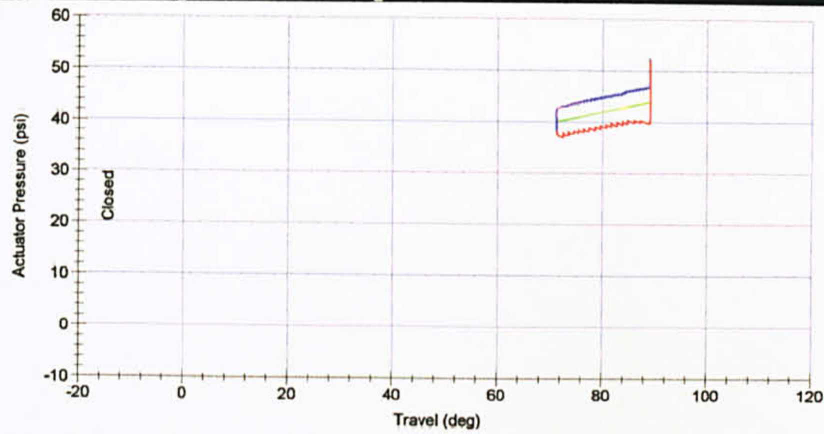
10 Mar 2009 16:19:50

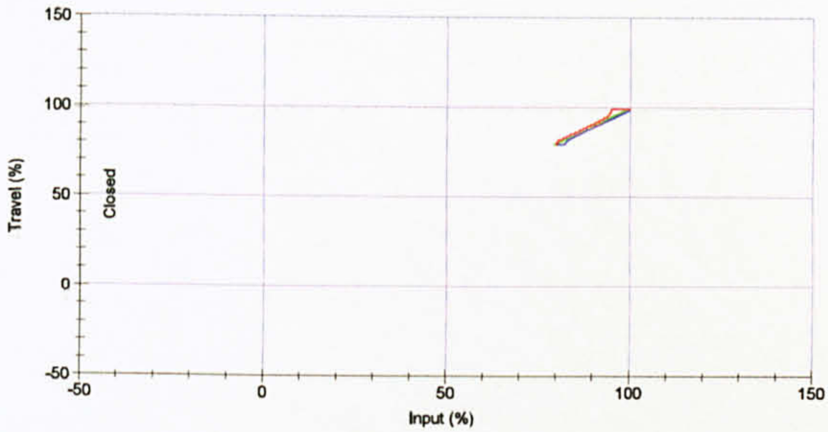
Spec Sheet Units	
Pressure Units	psi
Travel Units	deg
Length Units	in
Area Units	in2
Torque Units	lbf.in
Spring Rate Units	lbf/in
Valve	
Valve Mfg.	Fisher Controls
Valve Model	V-250
Size	6 in
Class	300
Rated Travel	90.0 deg
Actual Travel	90.0 deg
Stem Diameter	2.0 in
Packing Type	TFE / Single
Inlet Pressure	100.0 psi
Outlet Pressure	0.0 psi

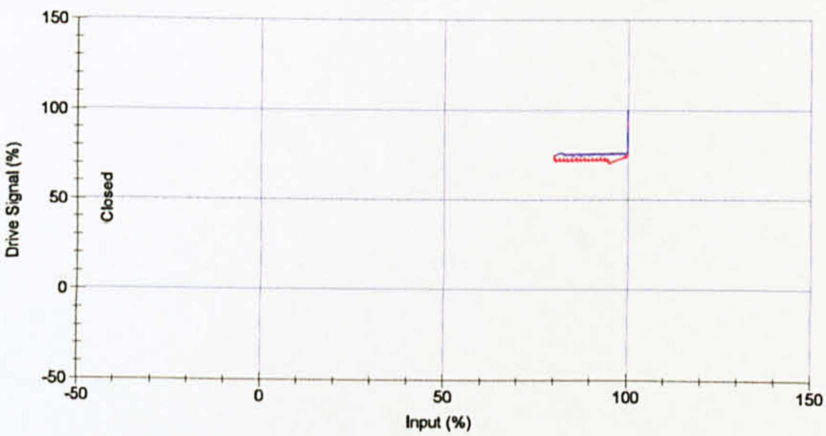
Trim	
Seat Type	Metal
Leak Class	V
Port Diameter	6.0 in
Actuator	
Actuator Mfg.	Fisher Controls
Actuator Model	1035
Actuator Size	40
Effective Area	0.0 in2
Air	Closes
Volume Booster/Quick Release	No
Lower Bench Set	0.0 psi
Upper Bench Set	0.0 psi
Nominal Supply Pressure	70.0 psi
Spring Rate	0.0 lbf/in
Lever Style	Rack and Pinion
Moment Arm	0.0 in

Reference	
Trim Style 1	
Trim Style 2	
Stroking Time Open (sec)	0
Stroking Time Closed (sec)	0
Dynamic Torque	0.0 lbf.in
Breakout Torque	0.0 lbf.in

Partial Stroke [BALL VALVE]







10 Mar 2009 16:20:06

Inputs

Input Start:	100.0 %
Input End:	80.0 %
Stroke Speed	0.5%/s
Test Pause Time:	5 sec
Collection Interval:	150.0 msec.

Analyzed Data

Avg. Dynamic Error:	2.16%
Min. Dynamic Error:	1.13%
Max. Dynamic Error:	2.98%
Dyn. Linearity (Ind.):	0.45%
Zero Ranged Travel at:	4.14 mA
Full Ranged Travel at:	20.04 mA
Average Torque:	NA
Minimum Torque:	NA
Maximum Torque:	NA
Spring Rate:	NA
Bench Set:	24.84 - 44.02 psi
Partial Stroke Test initiated by:	HART Command
Partial Stroke Test status:	Completed Successfully

Tuning Set

Tuning Set:	H
Gains	
Proportional:	8.40
Velocity:	4.20
MLF:	31.00
Integral Control:	Disabled
Integral Gain:	9.4

Notes

Valve

Manufacturer:	Fisher Controls
Type:	V-250
Size:	6 in
Class:	300
Rated Travel:	90.00 deg
Actual Travel:	90.00 deg
Shaft Diameter:	2.0000 in
Packing Type:	TFE / Single
Inlet Pressure:	100.0000 psi
Outlet Pressure:	0.0000 psi

Trim

Seat Type:	Metal
Leakage Class:	V
Port Diameter:	6.0000 in

Actuator

Manufacturer:	Fisher Controls
Type:	1035
Size:	40
Effective Area:	0.00 in2
Air:	Closes
Bench Set:	0.0000 psi-0.0000 psi
Nominal Supply Pressure:	70.0000 psi
Spring Rate:	0.0000 lbf/in
Style:	Rack and Pinion
Moment Arm:	0.0000 in

Instrument Configuration [BALL VALVE] - Basic

10 Mar 2009 16:29:27

General	
HART Tag	PST
Message	
Descriptor	18477410
Date	02/18/08
Valve Serial Number	18477410
Instrument Serial Number	18477410
Polling Address	0
Initial Setup	
Control Mode	Digital
Restart Cont. Mode	Digital
Zero Power Condition	Valve Closed
Travel / Pressure Cutoff Lo (%)	50
Valve Style	Rotary Shaft
Actuator Style	Piston - Sgl w/ Spring
Relay Type	Relay A or C
Feedback Connection	Rotary-All/SS-Roller
Travel Sensor Motion	Counter-clockwise
Aux Terminal Mode	Push Button Partial Stroke Test
Partial Stroke Start Pt.	Valve Open
Inputs	
Analog Input Units	mA
Temperature Units	F
Input Characterization	
Input Characteristic	Linear

Pressure	
Max Supply Pressure	60 psi
Pressure Units	psi
Tuning	
Travel Control	
Travel Control Tuning Set	H
Proportional	8.4
Enable Integral Control	No
Integral Gain (reps/min)	9.4
Integral Settings	
Integral Dead Zone (%)	0.26
Integral Limit (%)	50
Pressure Control	
Pressure Control Tuning Set	H
Proportional	4.2
Enable Integral Control	Yes
Integral Gain (reps/sec)	0.1
SIS / Partial Stroke	
Partial Stroke	
Enable	Enabled
Test Start Point	
Partial Stroke Press Limit	18 psi
Max. Travel Movement (%)	20
Test Speed	0.5%/s
Test Pause Time	5 sec
Auto Test Interval (days)	0.00
SIS Options	
DVC Power Up	Auto Reset
Action on Failed test	Step Back

Travel/Pressure Control	
Travel/Pressure Control	
Travel / Pressure Select	Travel
Travel / Pressure Cutoff Lo (%)	50
Travel / Pressure Cutoff Hi (%)	50
End Point Press. Control	
End Point Control Enable	Enabled
Control End	
Pressure Set Point	51.8 psi
Pressure Saturation Time (sec)	45
Dynamic Response	
Set Point Rate Limits	
SP Rate Open (%/sec)	0
SP Rate Close (%/sec)	0
Set Point Filter	
Lag Time (sec)	0

Instrument Configuration [BALL VALVE] - Alerts

10 Mar 2009 16:29:27

Self Test Shut Down

Flash ROM Fail Enable	No
No Free Time Enable	No
Reference Voltage Fail Enable	No
NVM Fail Enable	No
Temp Sensor Fail Enable	No
Travel Sensor Fail Enable	No
Drive Current Fail Enable	No
Travel History Alerts	
Cycle Count Alert Enable	No
Cycle Count Deadband (%)	2.93
Cycle Count Alert Point	2147483646
Cycle Count	347
Trav Acc Alert Enable	No
Tvl Accum Deadband (%)	2.93
Tvl Accum Alert Pt (%)	2147483646
Travel Accumulator (%)	23440

Deviation & Other Alerts

Travel Dev Alert Enable	Yes
Travel Dev Alert Pt (%)	5
Travel Dev Time (sec)	9.99
Pressure Dev Alert Enable	Yes
Pressure Dev Alert Pt	2 psi
Pressure Dev Time (sec)	9.99
Drive Signal Alert Enable	No
Supply Pressure Alert Point	0 psi
Supply Pressure Alert Enable	No
Travel Alerts	
Tvl Alert Lo Enable	No
Tvl Alert Hi Enable	No
Tvl Alert Lo Lo Enable	No
Tvl Alert Hi Hi Enable	No
Lo Point (%)	-25
Hi Point (%)	125
Lo Lo Point (%)	-25
Hi Hi Point (%)	125
Deadband (%)	1
Tvl Limit/Cutoff Lo Enable	No
Tvl Limit/Cutoff Hi Enable	No

Alert Record and Commands

Instrument Clock	10 JAN 2009 04:22
Valve Alerts Enable	No
Failure Alerts Enable	Yes
Misc Alerts Enable	No
Burst Mode Enable	No
Burst Command	3
Cmd #3 (Trending) Pressure	A
Alert Record Not Empty Enable	No
Alert Record Full Enable	No
Informational Status	
Inst Time Invalid Enable	No
Cal in Progress Enable	No
Autocal in Progress Enable	No
Diag in Progress Enable	No
Diag Data Avail Enable	No
Integrator Sat Hi Enable	No
Integrator Sat Lo Enable	No
Press Ctrl Active Enable	No
Multi-Drop Alert Enable	No
Electronic Alerts	
Shutdown Activated Alert Enable	No
Power Starvation Alert Enable	No
Non-Critical NVM Alert Enable	No

Instrument Configuration [BALL VALVE] - Spec Sheet

10 Mar 2009 16:29:27

Spec Sheet Units

Pressure Units	psi
Travel Units	deg
Length Units	in
Area Units	in2
Torque Units	lbf.in
Spring Rate Units	lbf/in
Valve	
Valve Mfg.	Fisher Controls
Valve Model	V-250
Size	6 in
Class	300
Rated Travel	90.0 deg
Actual Travel	90.0 deg
Stem Diameter	2.0 in
Packing Type	TFE / Single
Inlet Pressure	100.0 psi
Outlet Pressure	0.0 psi

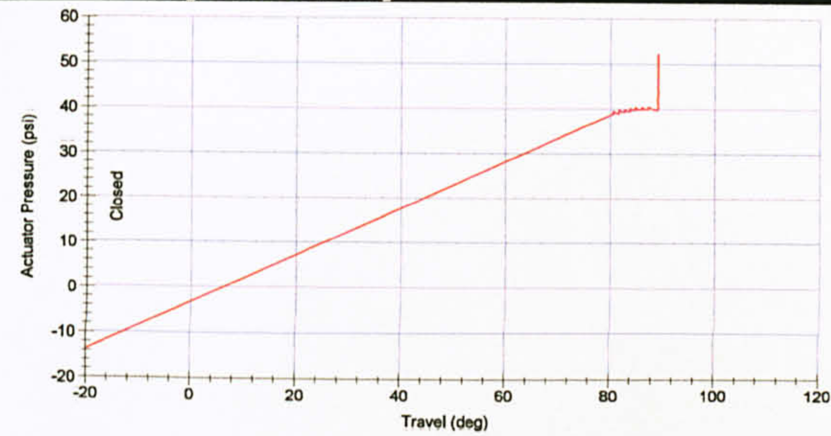
Trim

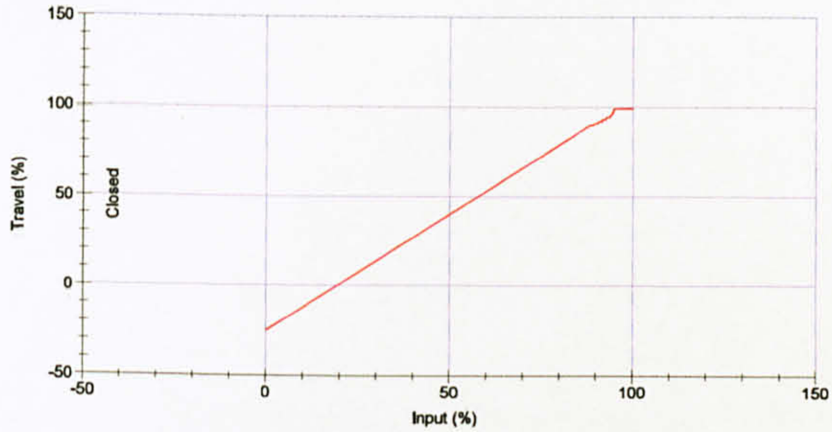
Seat Type	Metal
Leak Class	V
Port Diameter	6.0 in
Actuator	
Actuator Mfg.	Fisher Controls
Actuator Model	1035
Actuator Size	40
Effective Area	0.0 in2
Air	Closes
Volume Booster/Quick Release	No
Lower Bench Set	0.0 psi
Upper Bench Set	0.0 psi
Nominal Supply Pressure	70.0 psi
Spring Rate	0.0 lbf/in
Lever Style	Rack and Pinion
Moment Arm	0.0 in

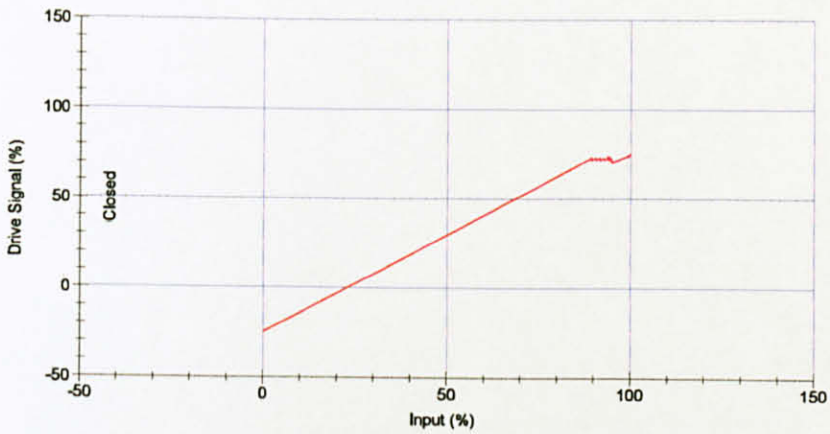
Reference

Trim Style 1	
Trim Style 2	
Stroking Time Open (sec)	0
Stroking Time Closed (sec)	0
Dynamic Torque	0.0 lbf.in
Breakout Torque	0.0 lbf.in

Partial Stroke [BALL VALVE]







10 Mar 2009 16:30:36

Inputs

Input Start:	100.0 %
Input End:	80.0 %
Stroke Speed	0.5%/s
Test Pause Time:	*5 sec*
Collection Interval:	150.0 msec.

Analyzed Data

Avg. Dynamic Error:	-10000.00%
Min. Dynamic Error:	-10000.00%
Max. Dynamic Error:	-10000.00%
Dyn. Linearity (Ind.):	-10000.00%
Zero Ranged Travel at:	-10000.00 mA
Full Ranged Travel at:	-10000.00 mA
Average Torque:	NA
Minimum Torque:	NA
Maximum Torque:	NA
Spring Rate:	NA
Bench Set:	NA
Partial Stroke Test initiated by:	HART Command
Partial Stroke Test status:	Completed Successfully

Tuning Set

Tuning Set:	H
Gains	
Proportional:	8.40
Velocity:	4.20
MLF:	31.00
Integral Control:	Disabled
Integral Gain:	9.4

Notes

Valve

Manufacturer:	Fisher Controls
Type:	V-250
Size:	6 in
Class:	300
Rated Travel:	90.00 deg
Actual Travel:	90.00 deg
Shaft Diameter:	2.0000 in
Packing Type:	TFE / Single
Inlet Pressure:	100.0000 psi
Outlet Pressure:	0.0000 psi

Trim

Seat Type:	Metal
Leakage Class:	V
Port Diameter:	6.0000 in

Actuator

Manufacturer:	Fisher Controls
Type:	1035
Size:	40
Effective Area:	0.00 in2
Air:	Closes
Bench Set:	0.0000 psi-0.0000 psi
Nominal Supply Pressure:	70.0000 psi
Spring Rate:	0.0000 lbf/in
Style:	Rack and Pinion
Moment Arm:	0.0000 in

APPENDIX E

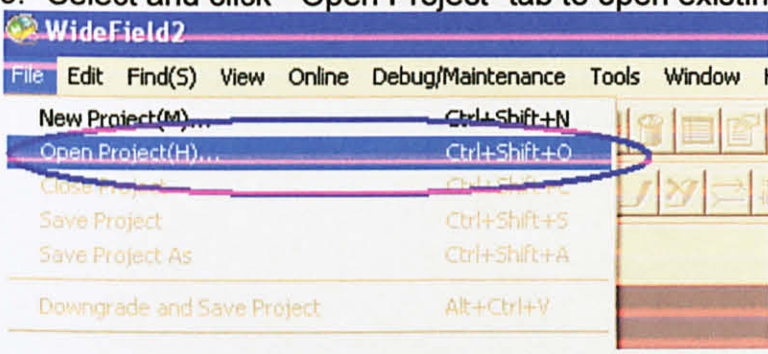
PROCEDURE TO PERFORM PST FOR FISHER SYSTEM

Procedure to Perform PST for Fisher Valve

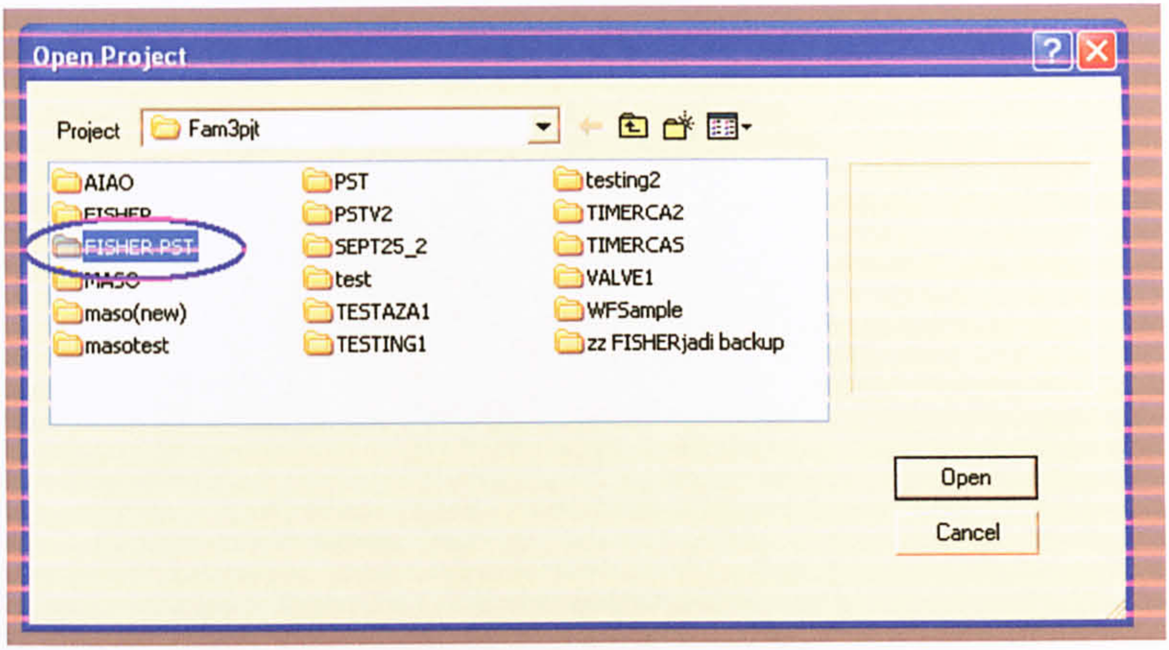
1. Check instrument air supply to the valve is in open condition.

2. To start using the program.
   Select and double click on WideField2 Icon to start using PLC program-WideField Software by Yokogawa

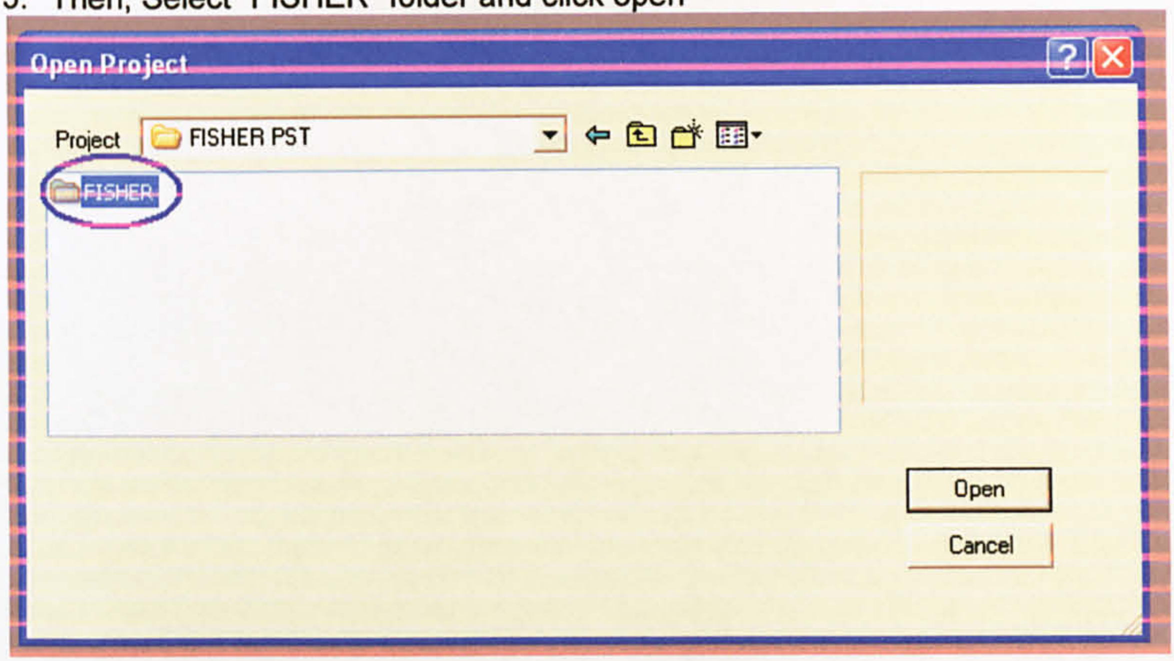
3. Select and click "Open Project" tab to open existing project file



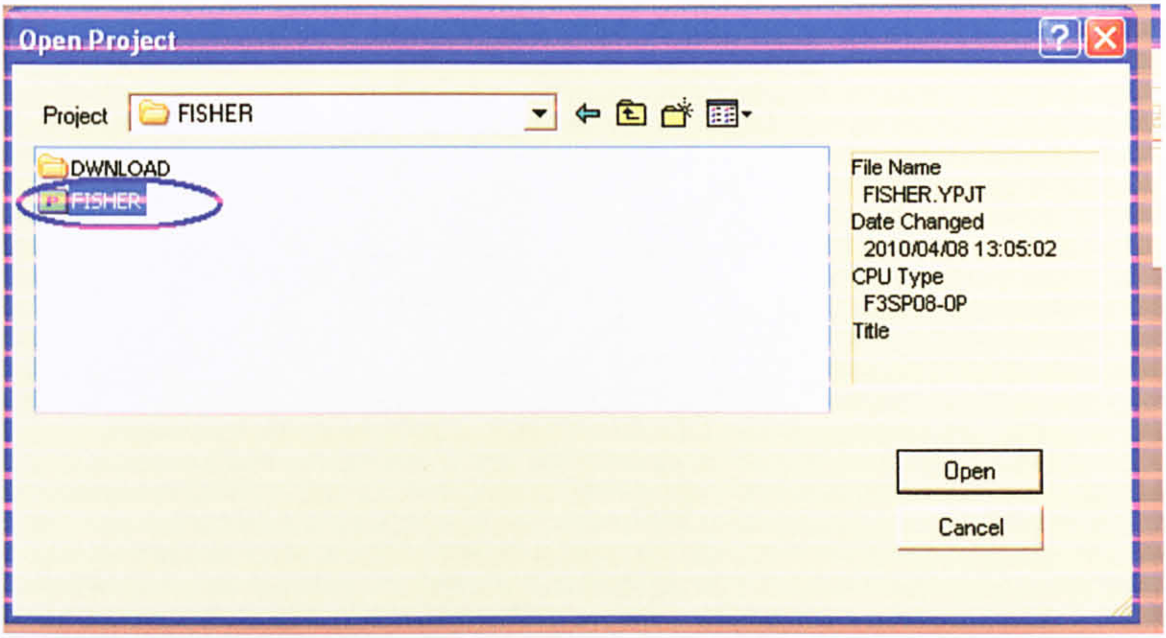
4. Select folder "FISHER PST" and click open



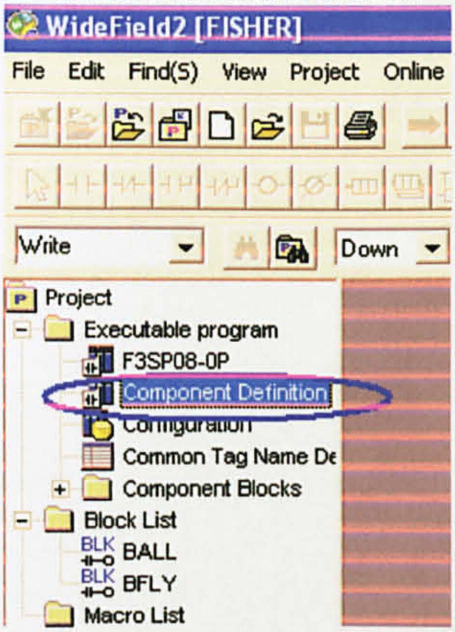
5. Then, Select "FISHER" folder and click open



6. Next, select "FISHER" folder and click open

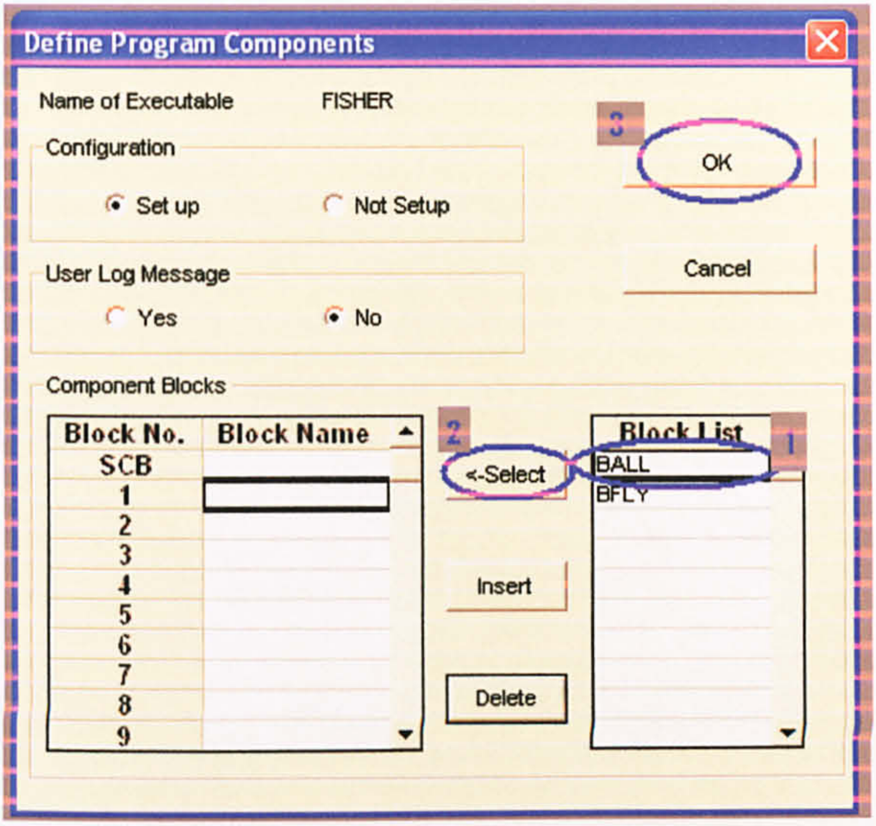


7. Select and double click on "Component Definition"



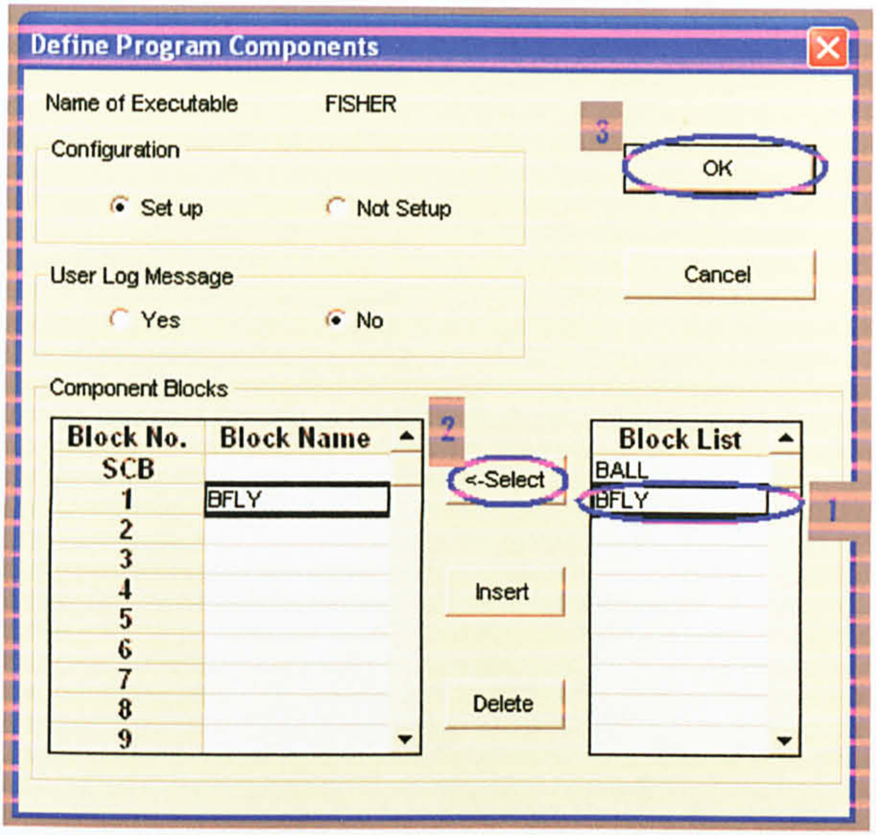
8a.To test Fisher Ball Valve:

- Select “BALL” from “Block List”, click “Select” and then click “OK”

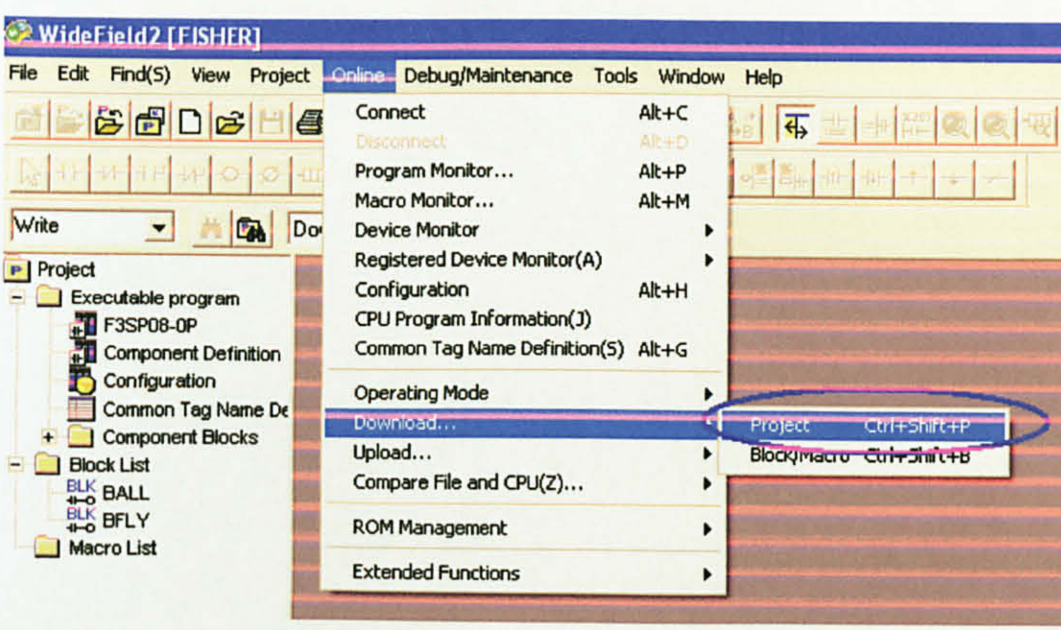


8b.To test Fisher Butterfly Valve:

- Select “BFLY” from “Block List”, click “Select” and then click “OK”

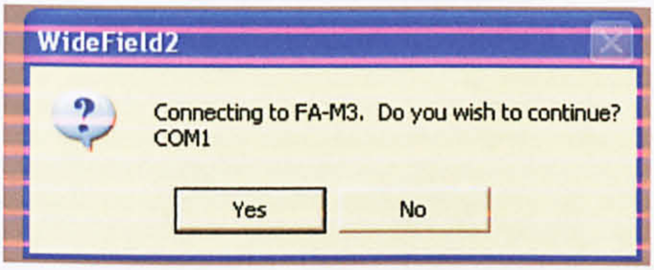


9. To download project file. Go to "Online", select "Download" and click on "Project"

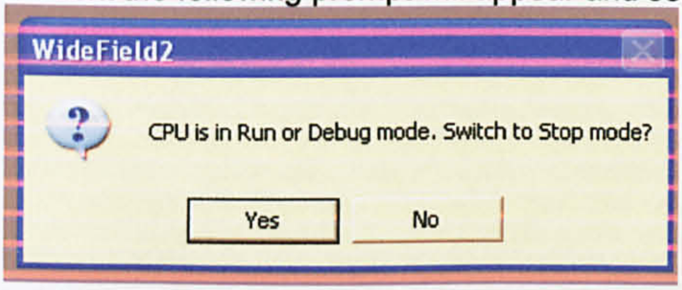


10. The following prompt will appear and select "YES"

11. Next the following prompt will appear and select "YES"

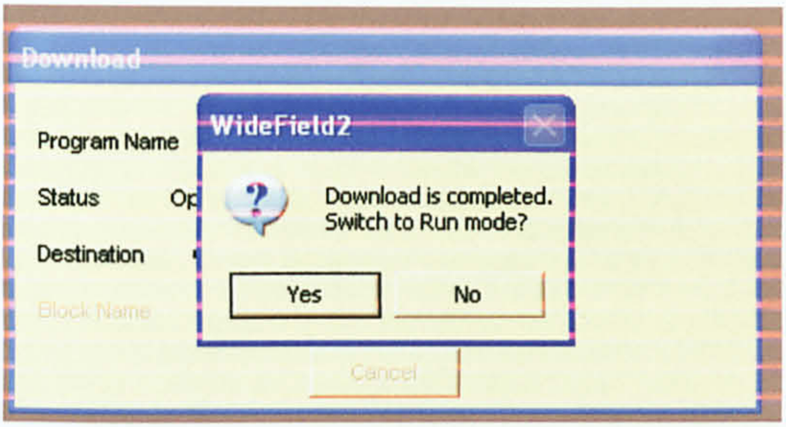


12. Next the following prompt will appear and select "YES" again.

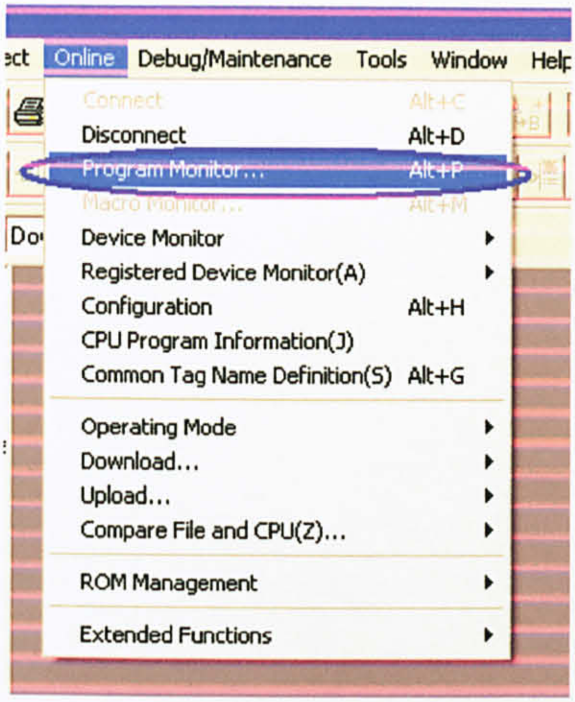


13. Transferring configuration will start to download and the following prompt will appear.

14. Wait until transfer configuration completed. Then, the following prompt will appear. Select "YES"

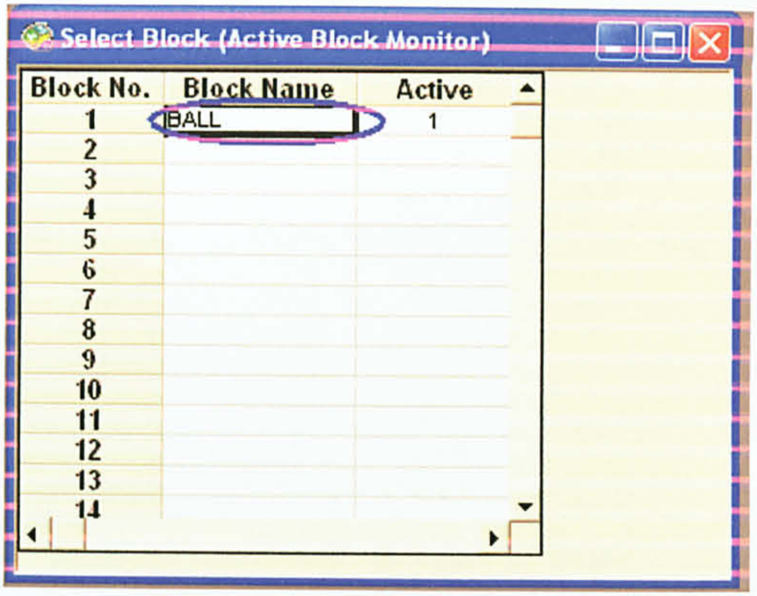


15. Next, to start program monitor. Go to "Online" and select "Program Monitor".

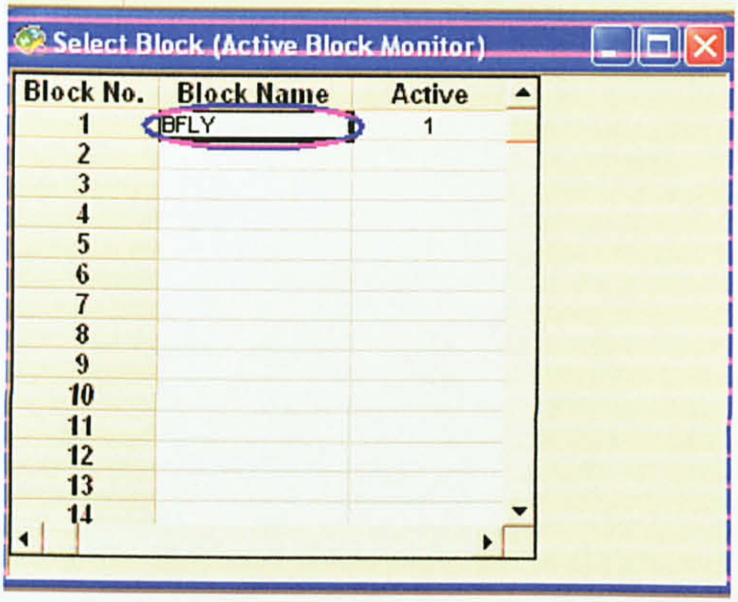


16. Next, the following block will appear.

a) For testing of Ball Valve: Double click on "BALL" to upload the ladder diagram.

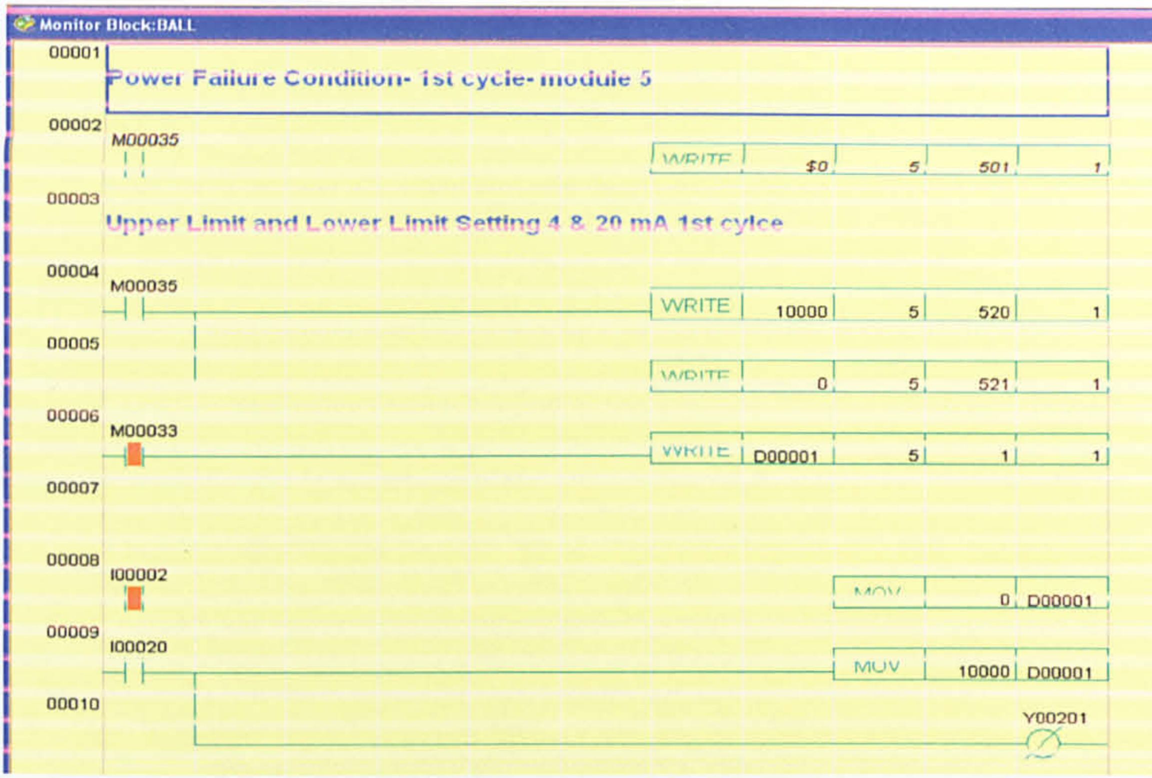


b) For testing of Butterfly valve: Double click on "BFLY" to upload the ladder diagram.

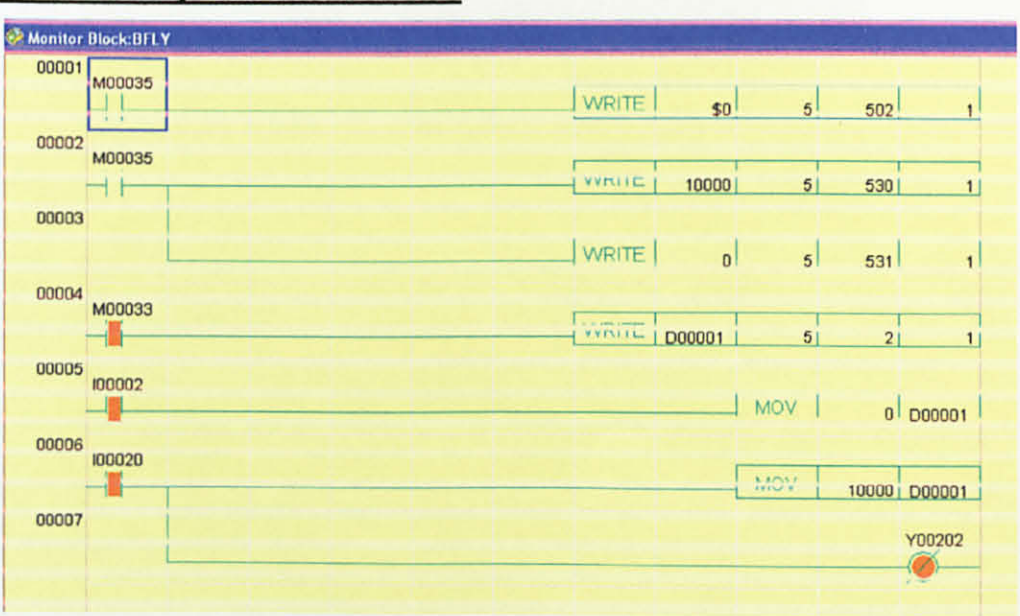


17. Upon successful uploading the ladder diagram will be displayed.

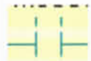
For Ball Valve as follows:



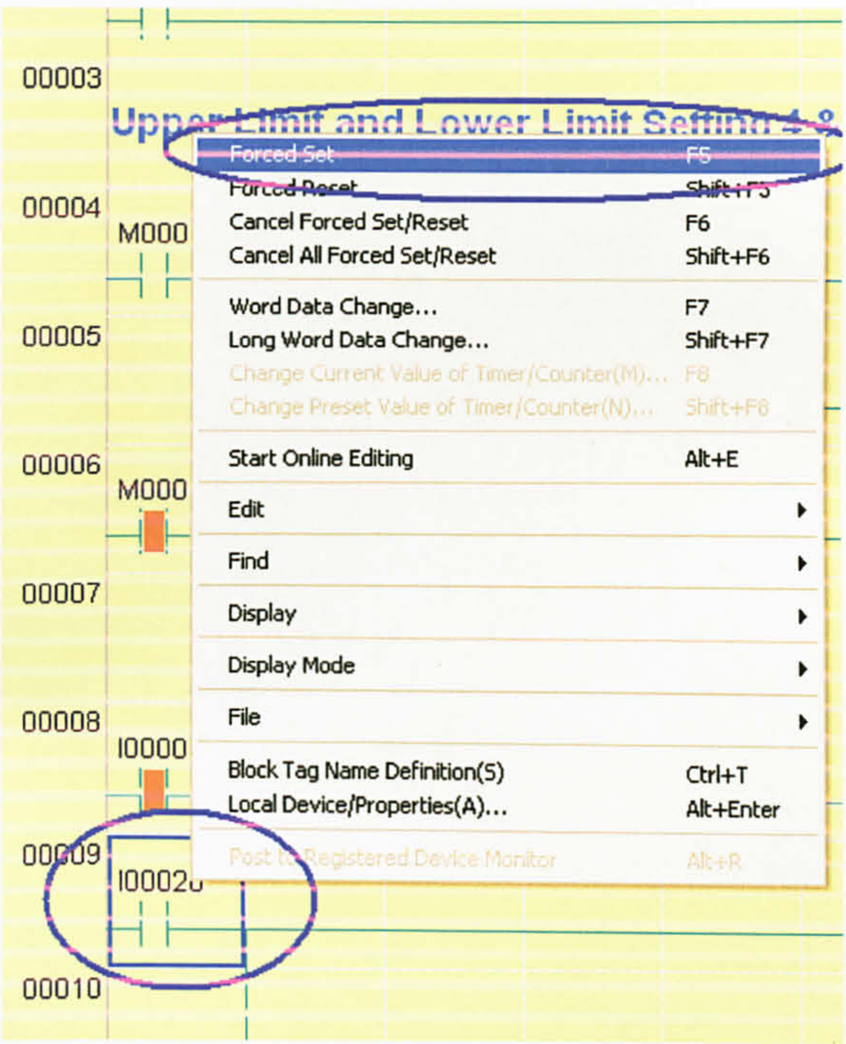
For Butterfly Valve as follows:



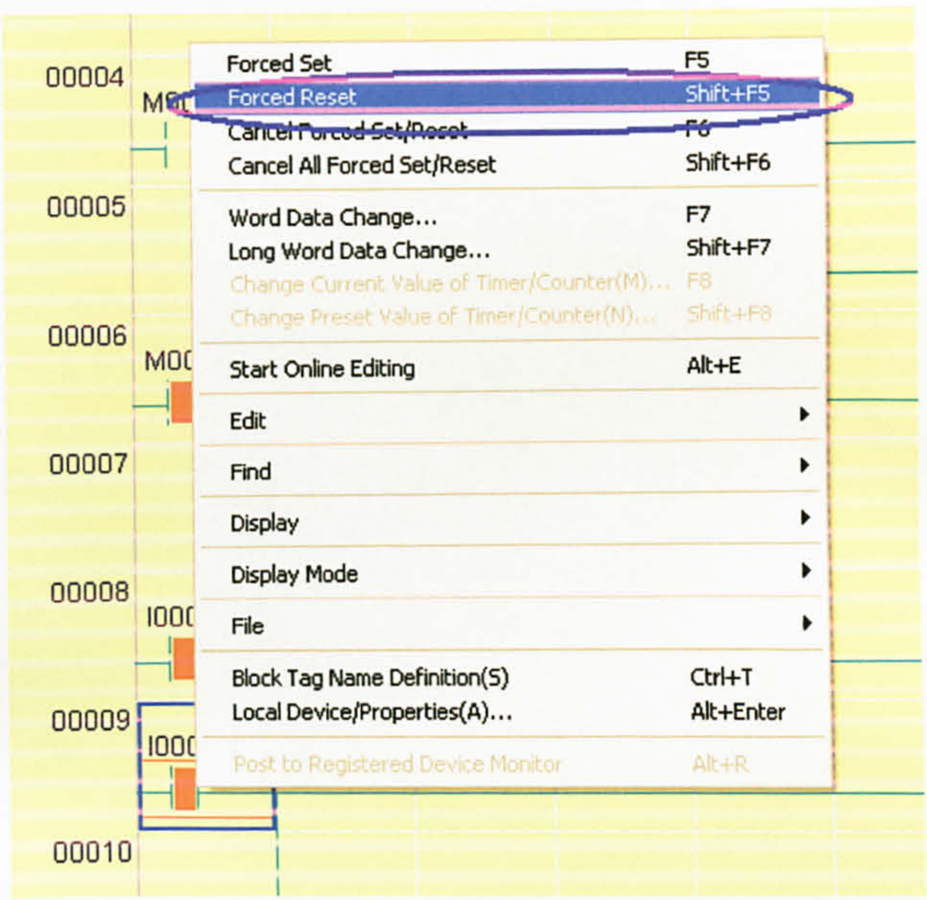
18. Ensure M00033 and I00002 are forced set. The symbol for set and reset is as follows:

SET	RESET
	

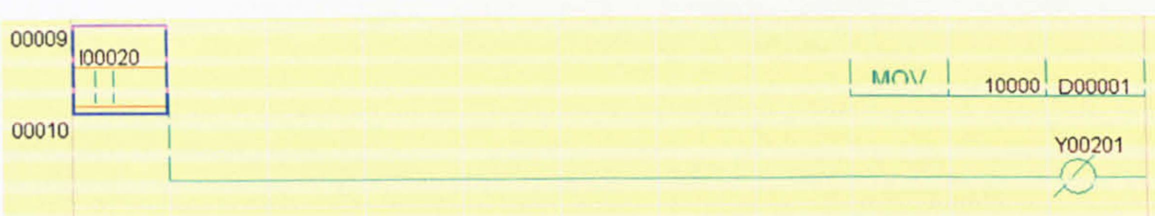
19. To do full stroke testing click on I00020. Then, select "Forced Set" to initiate closure of valve.



20. For Partial Stroke Testing, initiate opening of the valve by clicking on I00020. Then, select “Forced Reset” to initiate opening of valve.

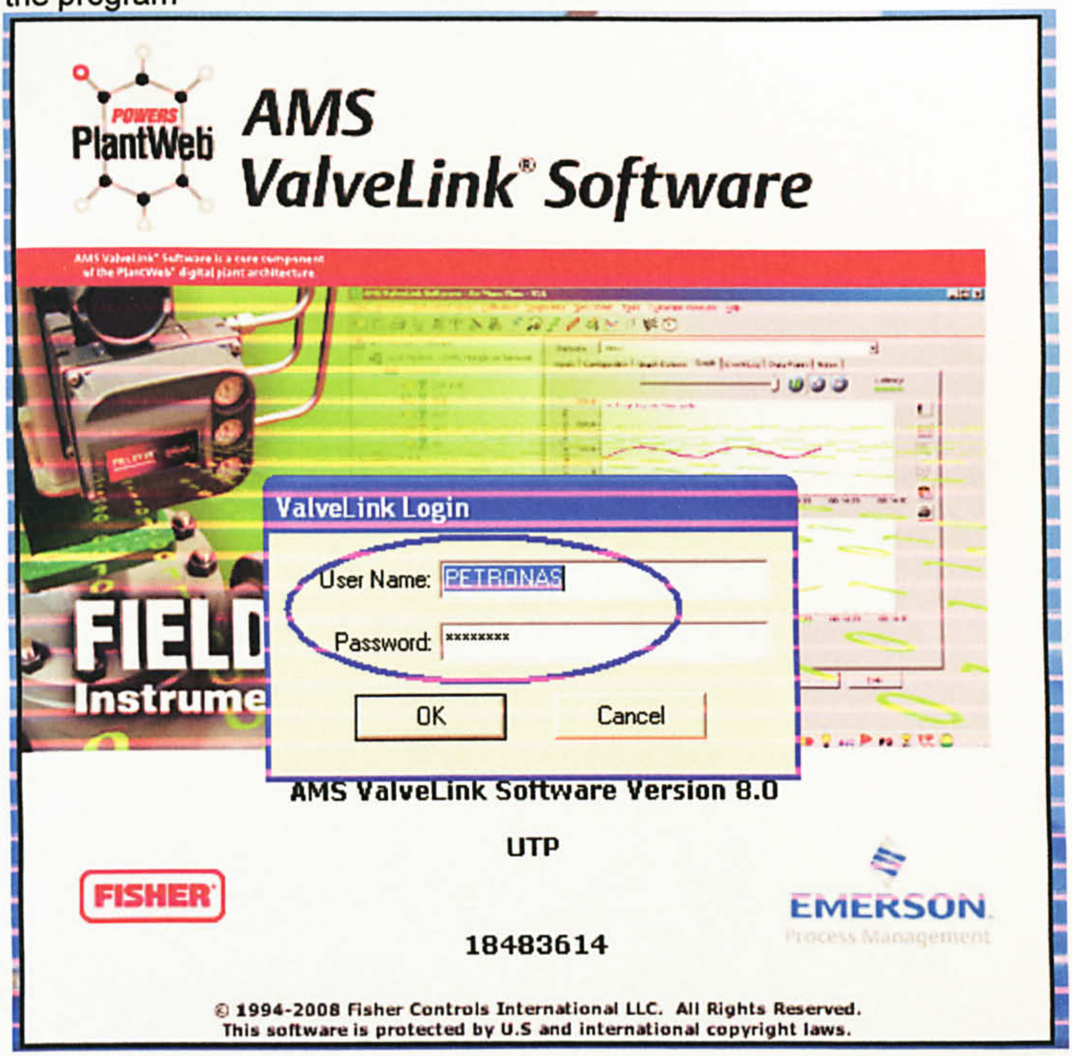


21. The valve should be in open condition (Forced Reset)

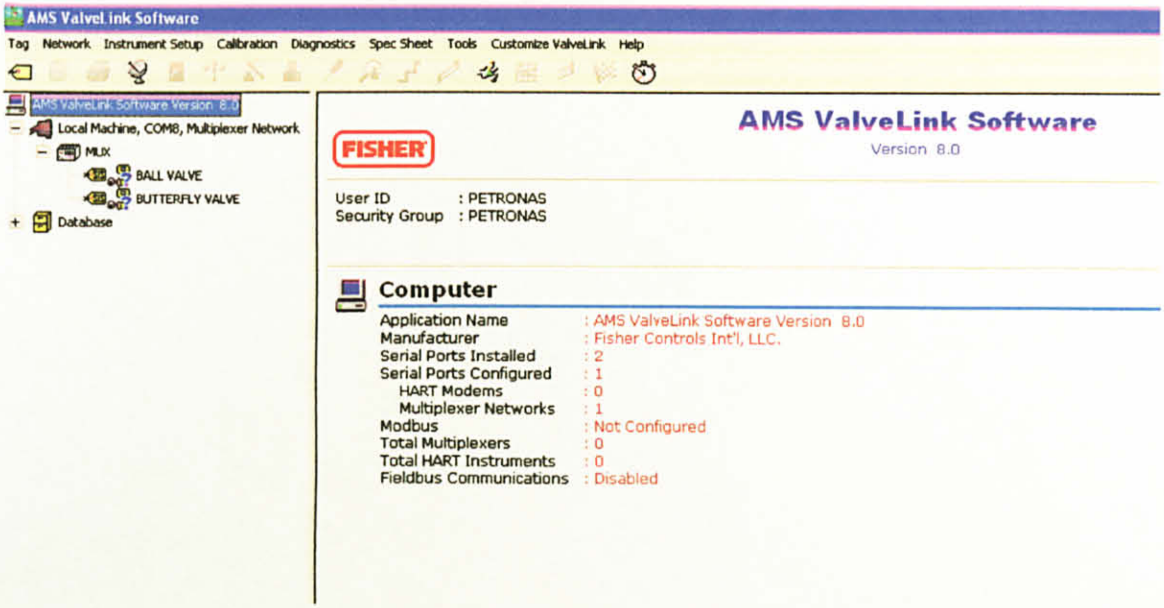


22. Then proceed to open AMS Valvelink Software. To start using the program. Select and double click on "ValveLink" Icon

23. Key in username "PETRONAS" and password "petronas" to start using the program

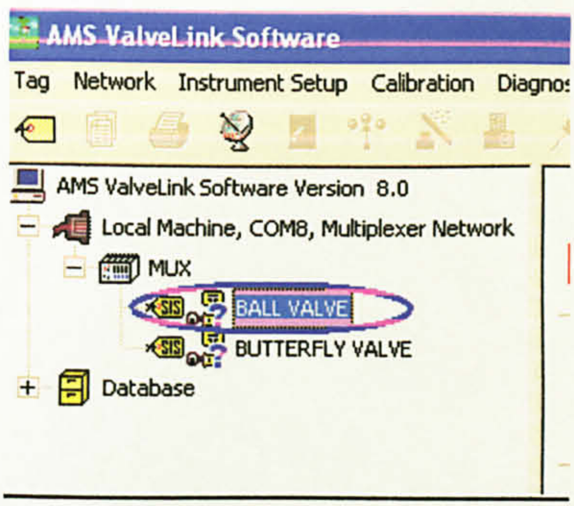


24. The software will be as follows:

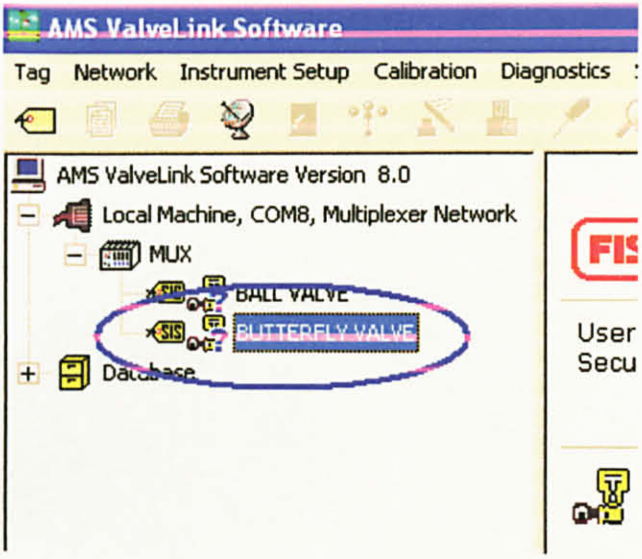


25. Initiate Partial Stroke Testing using AMS ValveLink Software

For Ball Valve as follows:



For Butterfly Valve as follows:

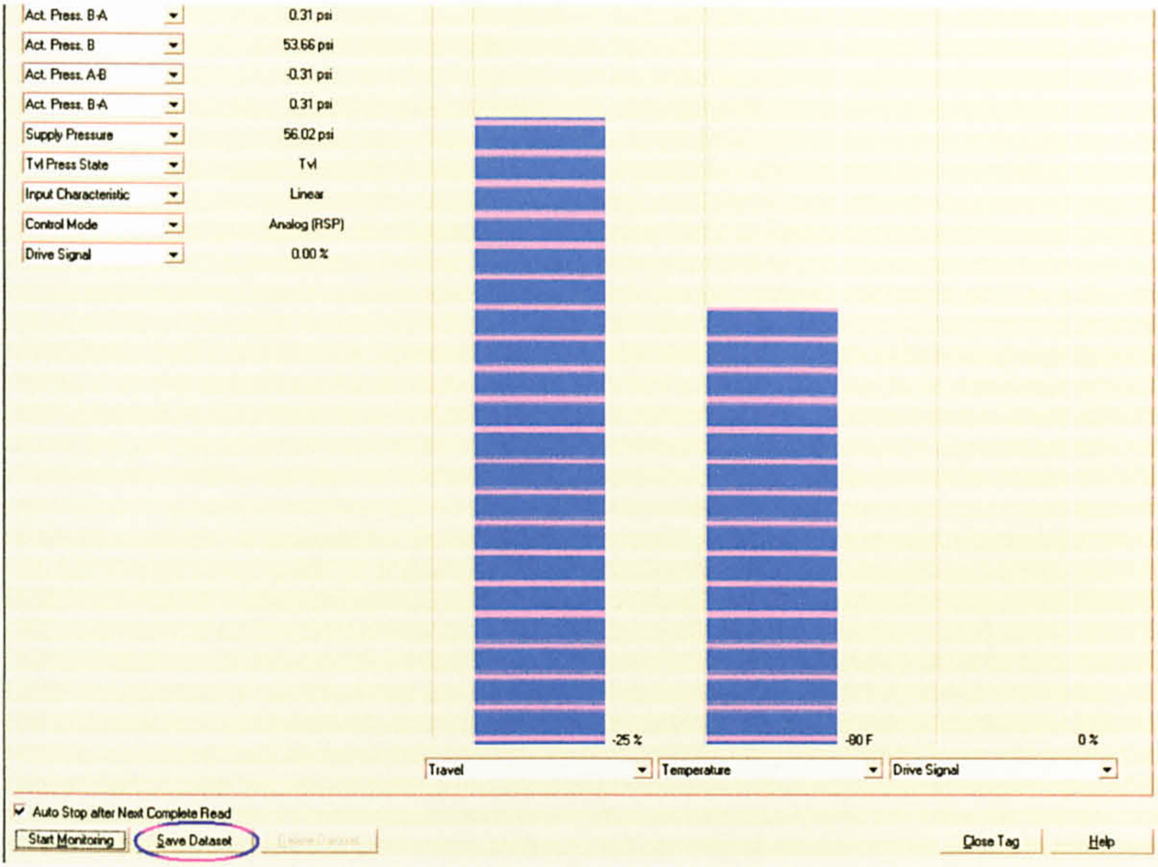


26. Double click on the chosen valve to run the PST.

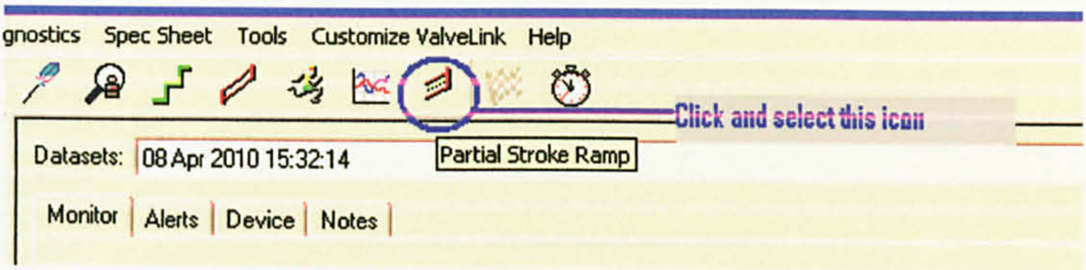
27. Tick and select on "Auto stop after Next Complete Read". Then, click on "Start Monitoring",


Monitor
Alerts
Device
Notes
Current Value
Travel Deviation
Act. Press. B-A
Act. Press. B
Act. Press. A-B
Act. Press. B-A
Supply Pressure
Tvl Press State
Input Characteristic
Control Mode
Drive Signal
Travel
Temperature
Drive Signal
Auto Stop after Next Complete Read
Start Monitoring
Close Tag
Help

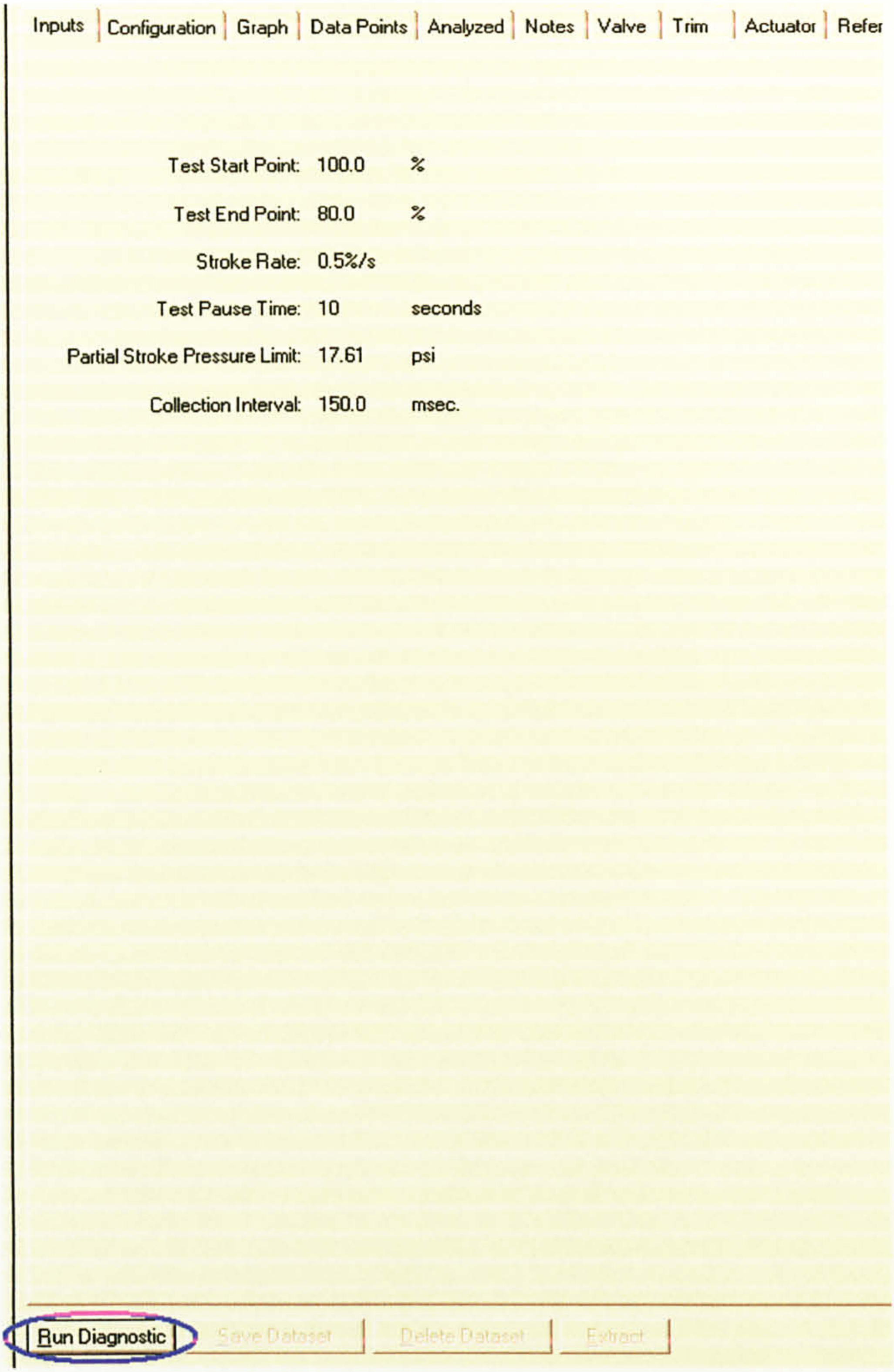
28. Program will start to monitor valve condition at site. Wait until data is displayed and "Save Dataset" tab is enable as follows. Click "Save Dataset" tab to save the data.



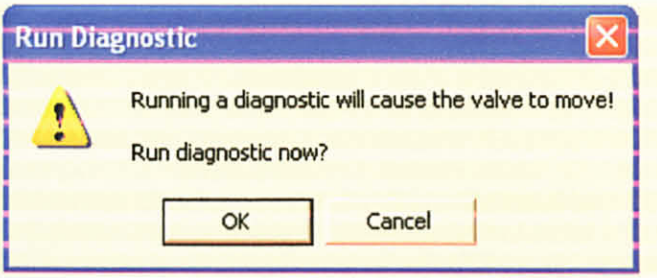
29. Click Partial Stroke Ramp icon to start Partial Stroke Testing Diagnostic



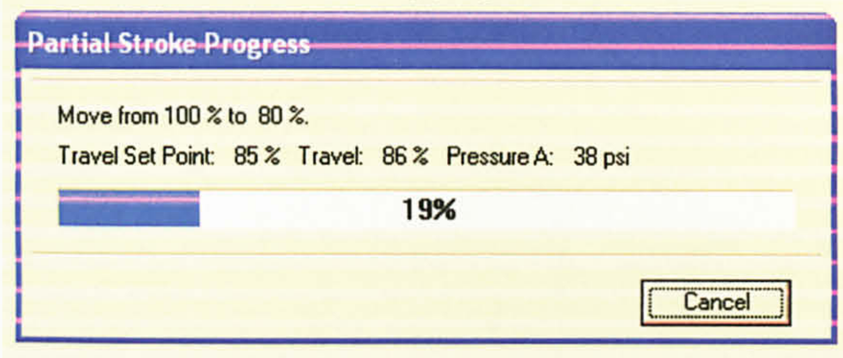
30. All the parameters have been set. These parameters need to be set only once. Next, click “Run Diagnostic”.


Inputs
Configuration
Graph
Data Points
Analyzed
Notes
Valve
Trim
Actuator
Refer
Test Start Point: 100.0 %
Test End Point: 80.0 %
Stroke Rate: 0.5%/s
Test Pause Time: 10 seconds
Partial Stroke Pressure Limit: 17.61 psi
Collection Interval: 150.0 msec.
Run Diagnostic
Save Dataset
Delete Dataset
Extract

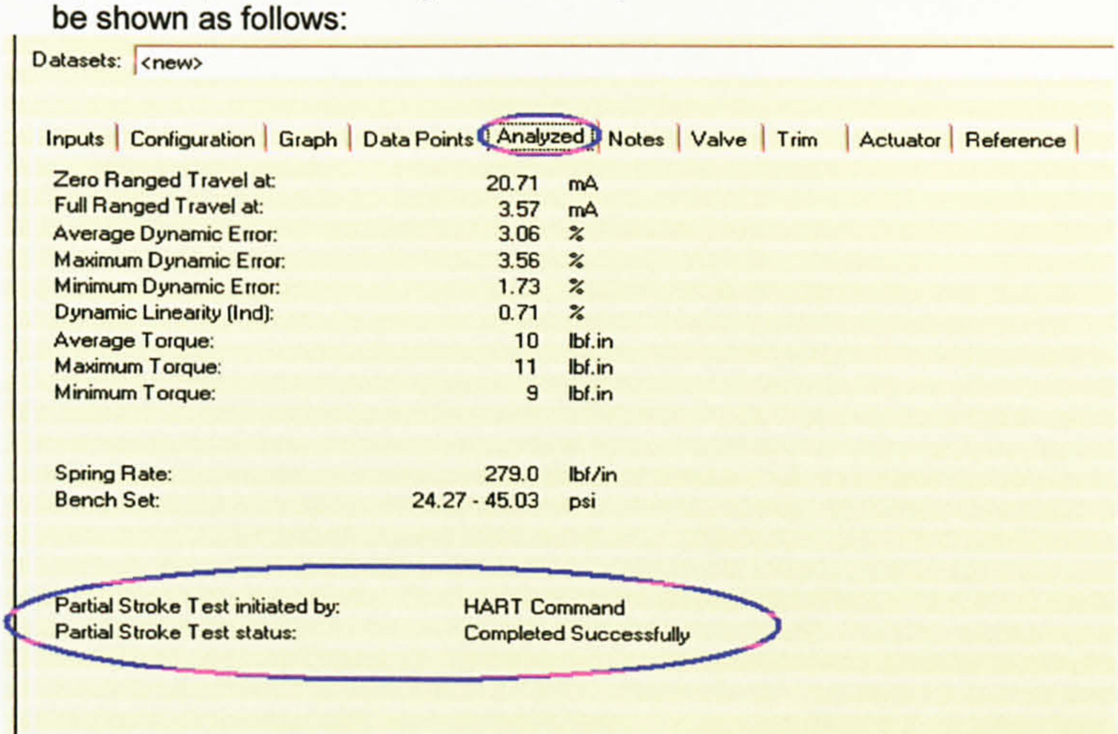
31. The following prompt will appear, select "OK"



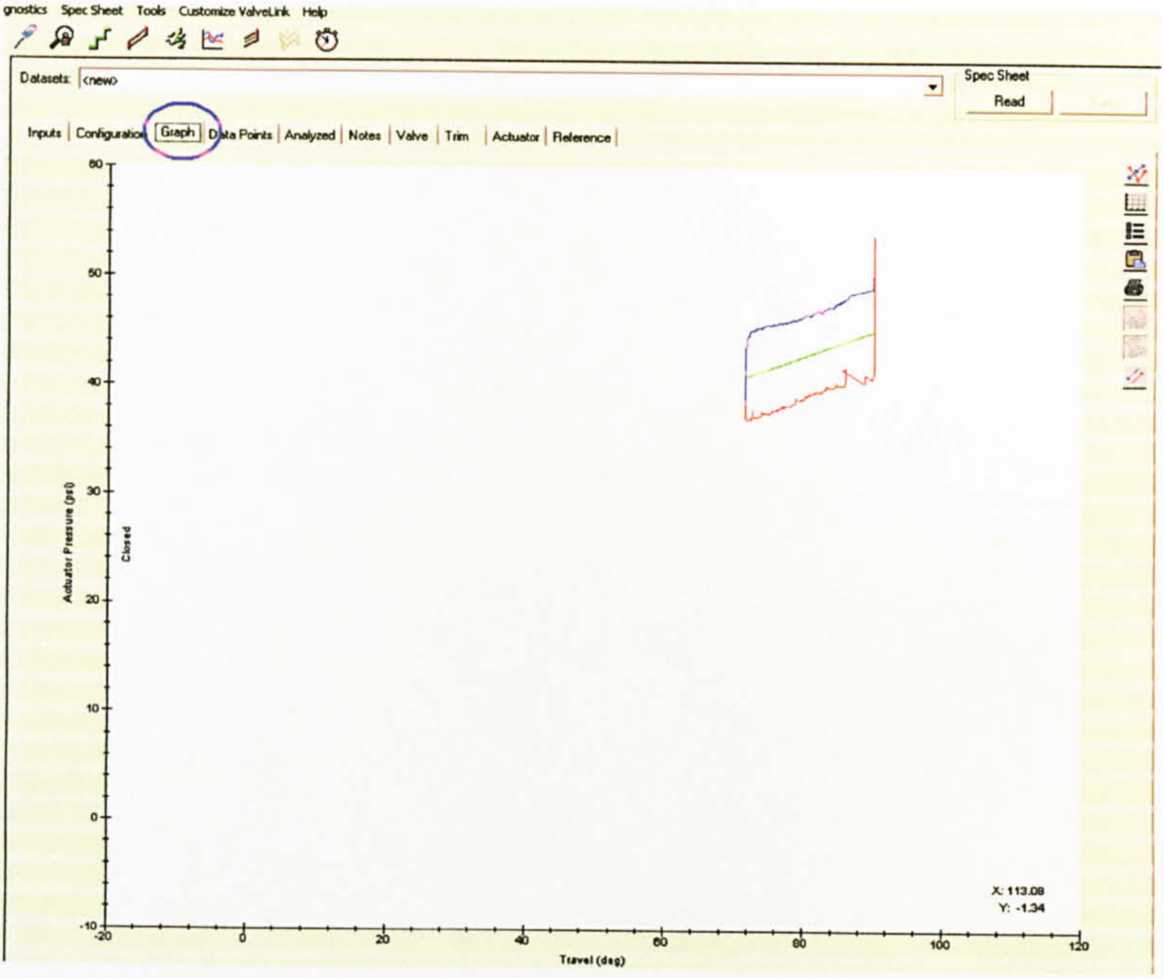
32. The Partial Stroke Testing progress window will be as follows:



33. upon completion of testing. Select Analyzed tab. The data record will be shown as follows:

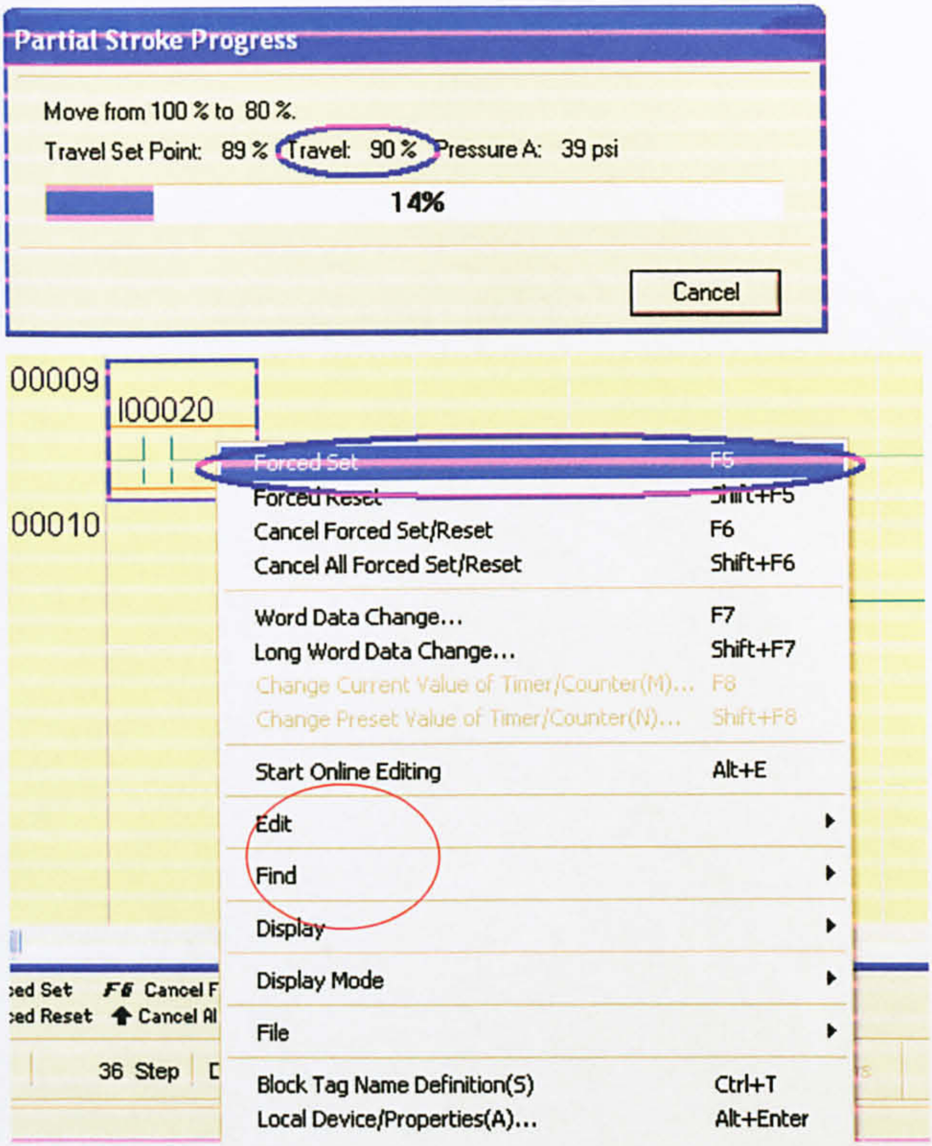


34. Next, select Graph tab. The Valve Signature will be shown as follows:



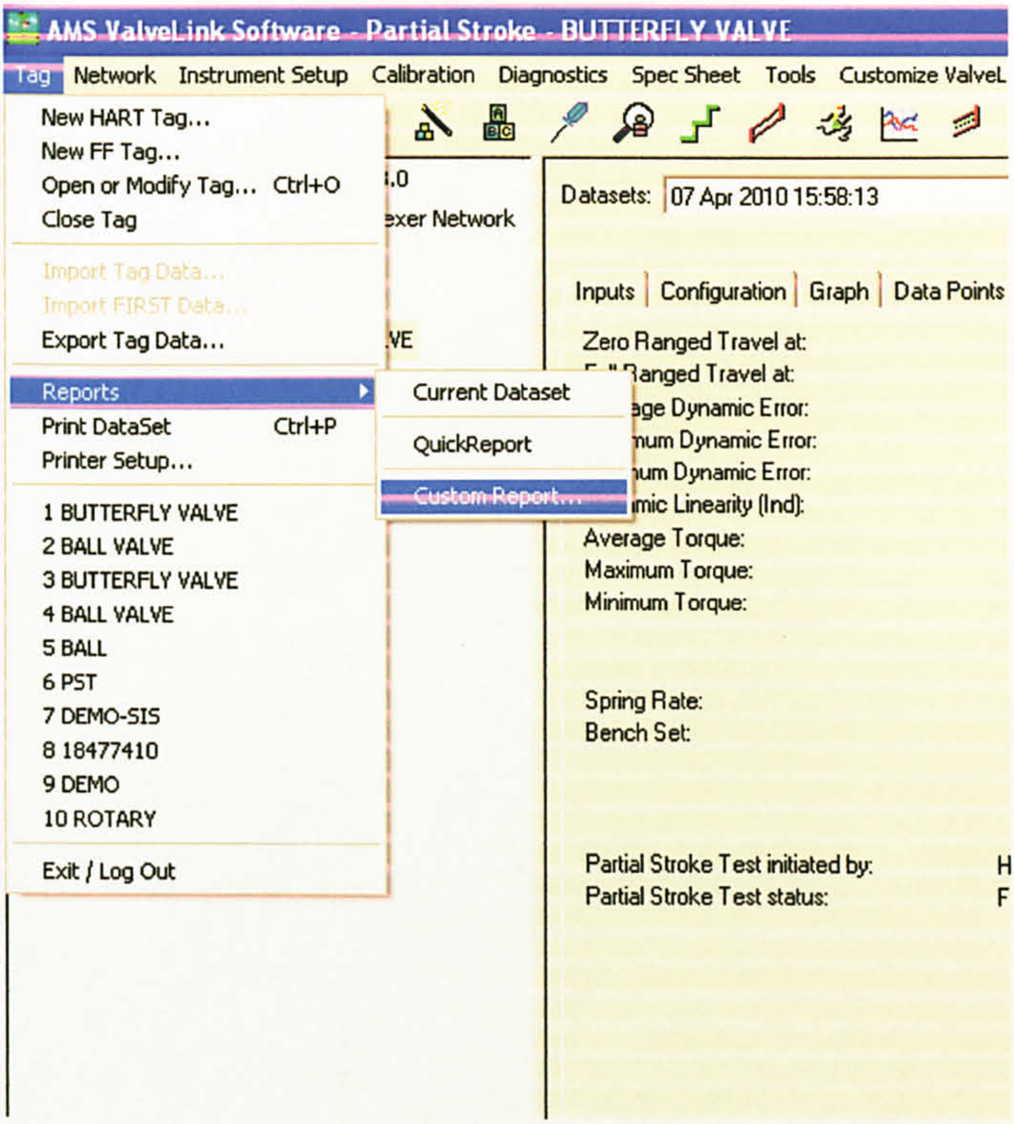
35. Save dataset and run diagnostic again to repeat PST and review new data set.

36. To perform FST while PST being run. Initiate FST from WideField when the travel reached 90% by initiating "Forced Set" the I00020.

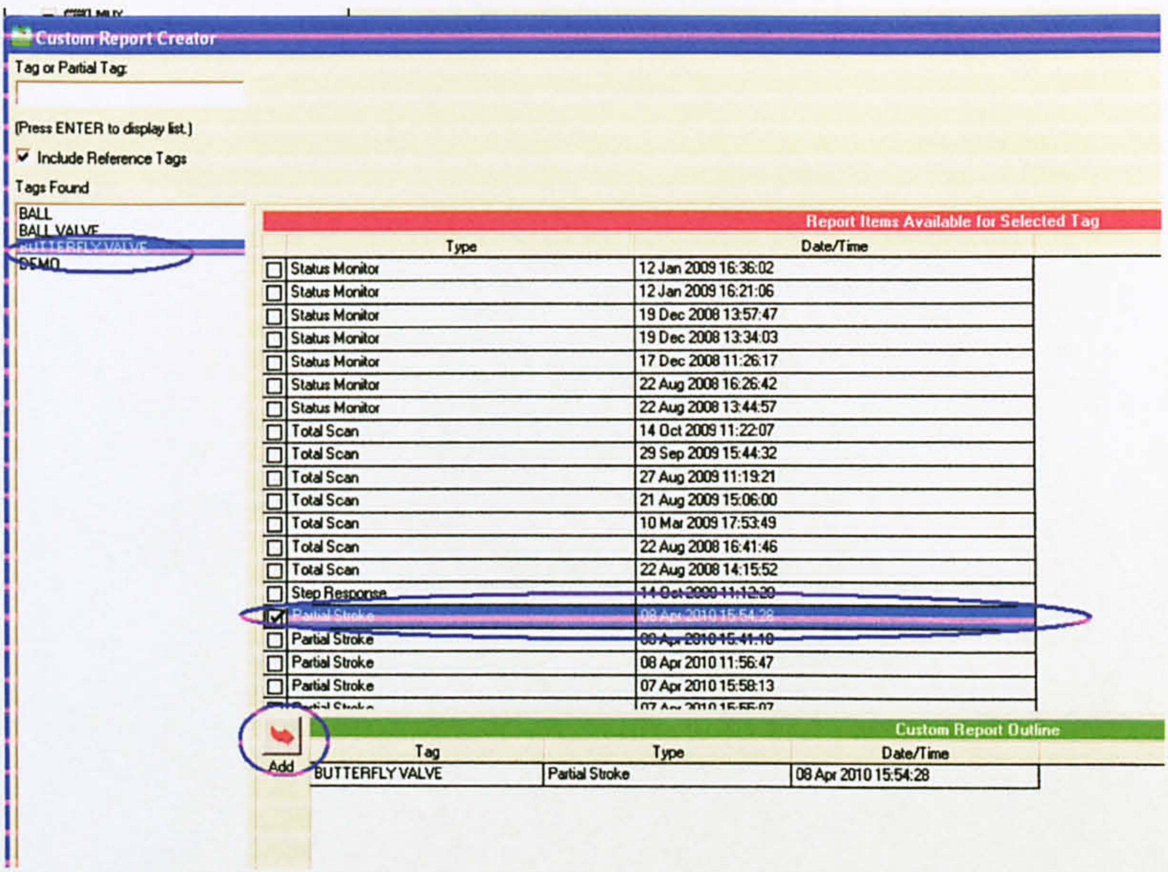


37. The valve should go to full close position and Partial Stroke Testing should abort. The following Error prompt will appear:

38. To generate report: Select "Tag", "Reports" and "Custom Reports"

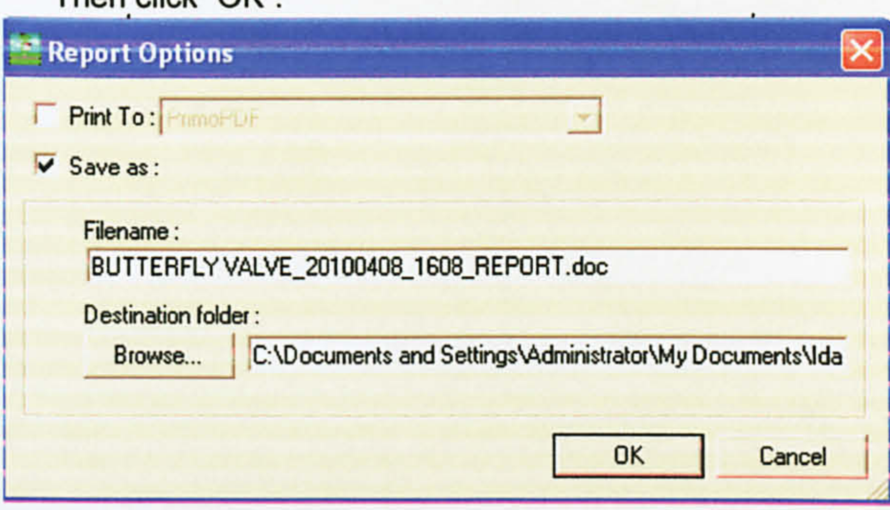


39. Select the applicable valve and selected tag for report to be generated. Example: Select "Butterfly Valve" under "Tags Found" and Select tag "Partial Stroke". Then, click "ADD"



40. Then click generate report.

41. Option pop-up will appear. Choose where to save the generate report. Then click “OK”.



Example of the generated custom report in PDF as per attached file. (APPENDIX B and APPENDIX C)